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Careers of PhD's: Academic Versus Nonacademic. A Second Report on Follow-up of Doctorate Cohorts 1935-1960.

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Data were collected on the careers of 10,000 holders of research degrees (PhDs, ScDs, and EdDs), via questionnaire, for a second study of PhD holders from the graduating classes of 1935, 1940, 1945, 1950, 1955, and 1960. The careers were systematically selected to represent a cross section of PhDs, and categorized into 4 groups: those always in academic employment, those shifting from academic to nonacademic jobs, those shifting from nonacademic to academic jobs, and those always in nonacademic positions. The report investigates career patterns in detail and illuminates factors related to a shift from academic to nonacademic employment or vice versa. Emphasis is placed on the categories of employers of PhDs and on factors related to change from 1 employer category to another. Some findings reveal that 50% of the PhDs spent their careers entirely in academic employment, 25% in nonacademic positions, and the remaining 25% were equally divided between those who shifted from academic to nonacademic jobs or vice versa. Annual rates of salary increase were typically about 8% for those always in or switching to academic work, higher rates were earned by those always in nonacademic work, while those shifting to nonacademic jobs were apt to receive an increase of almost 14% per annum. New PhDs, particularly those in the physical sciences, started on a higher academic level and advanced more rapidly than did their predecessors. (WM)

CAREER PATTERNS REPORT

PREPARED FOR THE NATIONAL INSTITUTES OF HEALTH

Careers of PhD's

Academic versus Nonacademic

NATIONAL ACADEMY OF SCIENCES

CAREER PATTERNS REPORT NUMBER TWO

Prepared for the National Institutes of Health under Contract PH 43-64-44

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A Second Report on Follow-up of Doctorate Cohorts 1935–1960

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HIGHLIGHTS

The careers of 10,000 holders of third-level research degrees (PhD, ScD, or EdD but not MD, DVM, or DDS), hereinafter abbreviated as PhD's, systematically selected from the graduating classes of 1935, 1940, 1945, 1950, 1955, and 1960 were examined in some detail in a report entitled Profiles of Ph.D's in the Sciences, published in 1965. These same careers are examined here in more detail, with respect to factors associated with choice of employment in academic or other settings. Particular attention was focused on circumstances surrounding a change in employer category. Some highlights of the findings are as follows:

- Half of the PhD's spent their careers entirely in academic employment and one fourth entirely in nonacademic employment. The remaining fourth were about equally divided between those who switched from academic to nonacademic jobs and those who switched in the opposite direction.
- Many variables related to background and educational factors were examined to try to discover whether later employer category or pattern of change in employer category might have been significantly affected by predoctoral experience. None of the variables explored was found to be systematically correlated with later career choice, with the possible exception of support during graduate school. Those with university support are slightly more likely to be found later in academe. No relation to government support—principally that obtained through the Veterans Administration—was discovered, but implications for later mission-oriented programs are unwarranted.
- Annual rates of salary increase were typically about 8% for those always in academic work or switching to academic work; slightly higher rates of increase were typical of those always in nonacademic work, while those switching out of academe were likely to get close to 14% per annum increases. Salary levels, as well as rates of increase, systematically favored those in nonacademic positions. Recently, annual rates of increase have improved in academe, but the general levels of salary remain distinctly below those of the nonacademic world.
- Those who switched from academe to elsewhere of course did little teaching in their new jobs, but they had done less teaching in their academic jobs than did those who remained. By switching, they gained a little research time but much more time in administrative duties. Those who switched into academic positions were doing a moderate amount of teaching on their old jobs but greatly increased their teaching time by the switch (from 12% to 50%). A desire to teach, or to avoid teaching, therefore appears to be an important determiner of career patterns.
- The academic ladder—instructor, assistant professor, associate professor, full professor—appears to be losing its lowest rung, at least as far as PhD's in the sciences are concerned. The new graduates start at higher levels and advance more rapidly than did their predecessors. Half of the PhD's are now reaching full professorships 10 to 12 years after the doctorate. Advancement has come most rapidly to the physical scientists, least rapidly to those in the humanities arts, professions group.

- Women's careers are less clear-cut than men's. Those of single women most closely resemble men's careers. Typically, women PhD's salaries are about three fourths those of men at equivalent intervals past receipt of the PhD degree. Fewer women are in the never-academic group; more switch back and forth between academic and nonacademic jobs; those always in academe are proportional to the numbers of men always in academic jobs. Academically oriented women bioscientists have the highest percentage of postdoctoral fellowships of any group of PhD's.

PREFACE

As our society becomes increasingly dependent upon its most highly trained segment, the importance of full utilization of the human potential of the population increases. This utilization can come about both by improvements in the education of the population and in the better utilization of those who have received advanced training. Improvements in both areas require a better understanding of the careers of those trained to the highest level.

It was this concern, shared by the Office of Scientific Personnel of the National Research Council and the Resources Analysis Branch, Office of Program Planning, of the National Institutes of Health (NIH), that initiated the study of career patterns reported herein. The Doctorate Records File of the Office of Scientific Personnel afforded a unique resource for launching this study, as it contains the names and other information concerning all recipients of U.S. third-level research degrees from 1920 to the present, totaling 255,000 through fiscal year 1967. Although many cross-sectional and other analyses of doctorate-holders have been made using this data bank and other sources such as the National Register of Scientific and Technical Personnel, there was a clear need for longitudinal studies to provide greater understanding of the career patterns of those trained to the highest level. Accordingly, questionnaires covering career information since their doctorates were sent to six graduation cohorts, 1935 through 1960; these provided data for slightly more than 10,000 individuals. The present report, based on these data, is the second of a contemplated series of three. The NIH has provided support for these studies and has widely distributed the first career patterns report, entitled Profiles of Ph.D's in the Sciences (National Academy of Sciences–National Research Council Publication 1293, NAS-NRC, Washington, D.C., 1965).

The highlights of the first report may be briefly summarized. Most holders of third-level research degrees (PhD's for short) work in colleges and universities, but over the past quarter-century the nonacademic sector of the PhD population has grown. The Midwest has been the largest single geographic source of PhD's, the South has become a major absorber of these people later in their careers. The number of PhD's engaged in research, and the average amount of time each spends in research, has increased over the years. Support for graduate education has tended to shift from personal and family sources to government since the end of World War II. Postdoctoral education has increased, principally with government support; the proportion of private support for postdoctoral training has diminished. As the educational level of the population in general has risen, the social base from which the PhD's have come has broadened; with each student generation the lower-income segment of the population has produced a relatively higher proportion of eventual doctorate holders. Rate of shifting from job to job, temporarily accelerated by World War II, has declined to prewar levels. The shifts occur chiefly among the less specialized and those not deeply engaged in research.

The present study has been focused primarily on the separation of the doctorate population into career patterns based on postdoctoral employment. Four general employment categories are considered: those always in academe, those always in nonacademic work, those who switch from academic to nonacademic jobs, and those who switch from nonacademic to academic employment. Particular attention is focused on factors related to the switching of employer categories. It is hoped that research on this question and the related questions of employment functions (teaching and research, for example), comparative salaries and salary advancement, postdoctoral training, support during graduate education, and research support may be useful in delineating patterns of utilization and may furnish some basis for decisions about how government or private support of education, both pre- and postdoctoral, may best be employed.

The forthcoming third report will focus on the more recent period, since 1963, the cut-off date for data collection in the present study, and will seek to compare the experience of a recent graduation cohort with that of the six cohorts of 1935 through 1960, analyzed in the first two reports.

The preparation of this report has involved the ideas and efforts of many persons. To the sponsors, the National Institutes of Health, go our thanks for initial support both of this volume and its predecessor. Dr. Herbert H. Rosenberg of NIH and his staff, including Dr. Allen O. Gamble and Mr. Wayne E. Tolliver, have offered invaluable suggestions at many points. Dr. Joan Creager deserves special mention for her indefatigable work in data analysis, especially in the chapter on women. Miss Clarebeth Maguire made signal contributions, particularly in the organization of complex data for graphic presentation. To Dr. William C. Kelly, Dr. Joseph C. Boyce, Dr. Conrad Taeuber, Dr. William J. Baumol, and Dr. Fred D. Boercker go thanks for their critical review of the manuscript and many valuable suggestions. Mrs. Doris Rogowski has contributed enormously at all stages of data processing and in the editorial review of the manuscript. Mr. Robert T. Farr did an excellent job of computer programming. To all of these, and to the 10,000 people who gave time, effort, and basic information by completing the questionnaires upon which the study is based, my deepest gratitude.

NIH provided funds for the preparation of this report. The continuing assistance of the NIH for the forthcoming third report is gratefully acknowledged.

Lindsey R. Harmon
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CONTENTS

TABLES AND FIGURES

TABLES

FIGURES

INTRODUCTION

The role of high-level manpower in the welfare of the country—its growth, its economic strength, the health of its people—has become more widely perceived as the key factor in many kinds of development. One segment of this leadership group is defined as those people who hold research doctorates. It is this group that is the focus of the present report, which deals with the careers of 10,000 of these people, systematically selected to represent a cross section of PhD's, but with a heavy weighting in the health-related sciences. Information was obtained from these people by questionnaire, a copy of which is given in Appendix 1 of our 1965 report.* Details of the sampling procedure are given in pages 1 to 4 and in Appendixes 2 and 3 of that report.

The optimal utilization of highly trained people is dependent on their having careers that, considered as a whole, provide for the maximal realization of their potential for productive accomplishment. How can this be done? Very little is actually known regarding the career patterns of any significant segment of the population, for the very understandable reason that analysis of careers is a long-term operation and very expensive, and because careers are almost infinitely varied. Cross-sectional studies of people in various occupational groups at various points in time can afford valuable information but fall short of describing the dynamics of careers. Those in one cross-sectional sample may be quite different individuals from the people in another sample at a different point in time, even if great care is taken to make the samples equally representative. People change jobs, change fields of employment, change in geographic location, and change in category of employer. How much do they change, and what are the factors involved in such changes? Very little is known at present. The present report is an attempt to draw forth from longitudinal data important inferences regarding careers.† From such results it is hoped that those concerned with the education and employment of high-level personnel will be enabled to draw conclusions of value to policy questions of many kinds. It is recognized that this is a pioneering effort, and that the very analysis of the data may uncover deficiencies that will require correction in future studies of this nature and may suggest research procedures different from those of the present report.

This report attempts to investigate what might be termed the finer structure of career patterns, as compared with the broad outlines given in the previous report, and in particular to help illuminate factors involved in switching from academic to nonacademic employment or vice versa. For this very reason,

*Lindsey R. Harmon, Profiles of Ph.D's in the Sciences, NAS-NRC Publ. 1293, Nat. Acad. Sci.—Nat. Res. Council, Washington, D.C., 1965.

†Another result of this recognition is the enormous task undertaken by the National Science Foundation to assemble into longitudinal records the many discrete reports gathered heretofore in the National Register of Scientific and Technical Personnel. When this task is completed, the resulting data bank will make possible many valuable career-pattern studies.

some of the discussion becomes rather detailed and sometimes rather technical. An attempt will be made in the body of the text to keep such detailed technical issues to a minimum, with due cautions as to the limits of generalization; the appendixes will provide in more detail the information with regard to sampling procedures and research techniques.

This report varies from the previous one not only in its more limited though intense focus on a smaller number of specific issues but also in the use of more refined techniques. For instance, in the first report, each individual was treated equally, regardless of the size of the population that he represented. In the present report, the matter of sampling is handled with meticulous care, so that each individual is given a "weight" in the data analysis which is proportional to his representativeness in the whole doctorate population. A given segment of this population may, for example, include 200 people in a given year, one half of whom may have been in the present sample; but only 80% of those sampled may have returned usable questionnaires. Each usable questionnaire returned would then represent 2.5 individuals (200/80). In another segment, each respondent might stand for 1.7 individuals, or 5.3, or whatever number would represent the proper multiplier so that, if the whole sample were "blown up" by these weights, the result would be a reproduction of the original parent population. Although this weighting procedure would not be expected to—and did not—produce large differences in the results, it does provide added confidence that each segment of the population is appropriately represented, and that the results as found afford the best basis for generalization that could be provided by the data. Details of the weighting procedure are given in Appendix A. All calculations of means and percentages in the study are based on the "blown-up" sample, except where otherwise noted or when the original number of observations was required for statistical tests. Several tables report actual numbers; these are not blown up statistically; percentage figures use the weights, except for the description of the employer categories in Figure 1.

The various groups used in the analyses were carefully defined. Experience patterns, defined by the categories of employer and by the time and direction of shift from one category to another, are described. These categories are also sorted out by graduation cohort and by general field of doctoral degree. This results in a large number of groups and considerable intricacy of the data. A conscientious attempt has been made to see that the maze of necessary detail has not obscured such generalizations in the data as may be useful. It is hoped that this effort has been effective in presenting with some degree of clarity the career patterns of men and women holding research doctorates.

CHAPTER I PATTERNS OF EMPLOYMENT EXPERIENCE

In this report on career patterns, chief emphasis will be placed on the categories of employers of PhD's and on the factors related to change from one employer category to another. As a general background for consideration of the changes that occur for the various groups of doctorate holders, a sketch of the over-all experience of the various graduation cohorts from the year of graduation to 1963, the cut-off date of the survey, will be useful. Cohorts were defined as follows:

Cohort	Year of PhD Graduation
1	1935
2	1940
3	1945
4	1950
5	1955
6	1960

Figure 1 will be helpful in this connection. It illustrates the employment experience of each graduation cohort in terms of the employers* for whom these people worked. The top left portion in Figure 1 concerns the people who took their PhD degrees in 1935 (Cohort 1). The subsequent cohorts are shown successively on the page. It is apparent at a glance that throughout the careers of these people academic employment was the rule for most of them. Business and industry was the second largest single category. Civilian employment by the U.S. Government was third largest. All other employers are grouped into a single aggregate category. This "all other" category includes military service during World War II, as this was in the nature of an interruption in careers rather than constituting a career in itself. The effect of this interruption is seen in the period 1945 for the first two graduation cohorts (1935 and 1940). The "all other" category is large in 1945 for the 1935 cohort and much larger for the 1940 cohort. The 1940 graduates were younger and consequently more of them than of the 1935 cohort went into military service during World War II. Military service is a minor factor in all the subsequent PhD graduation cohorts.

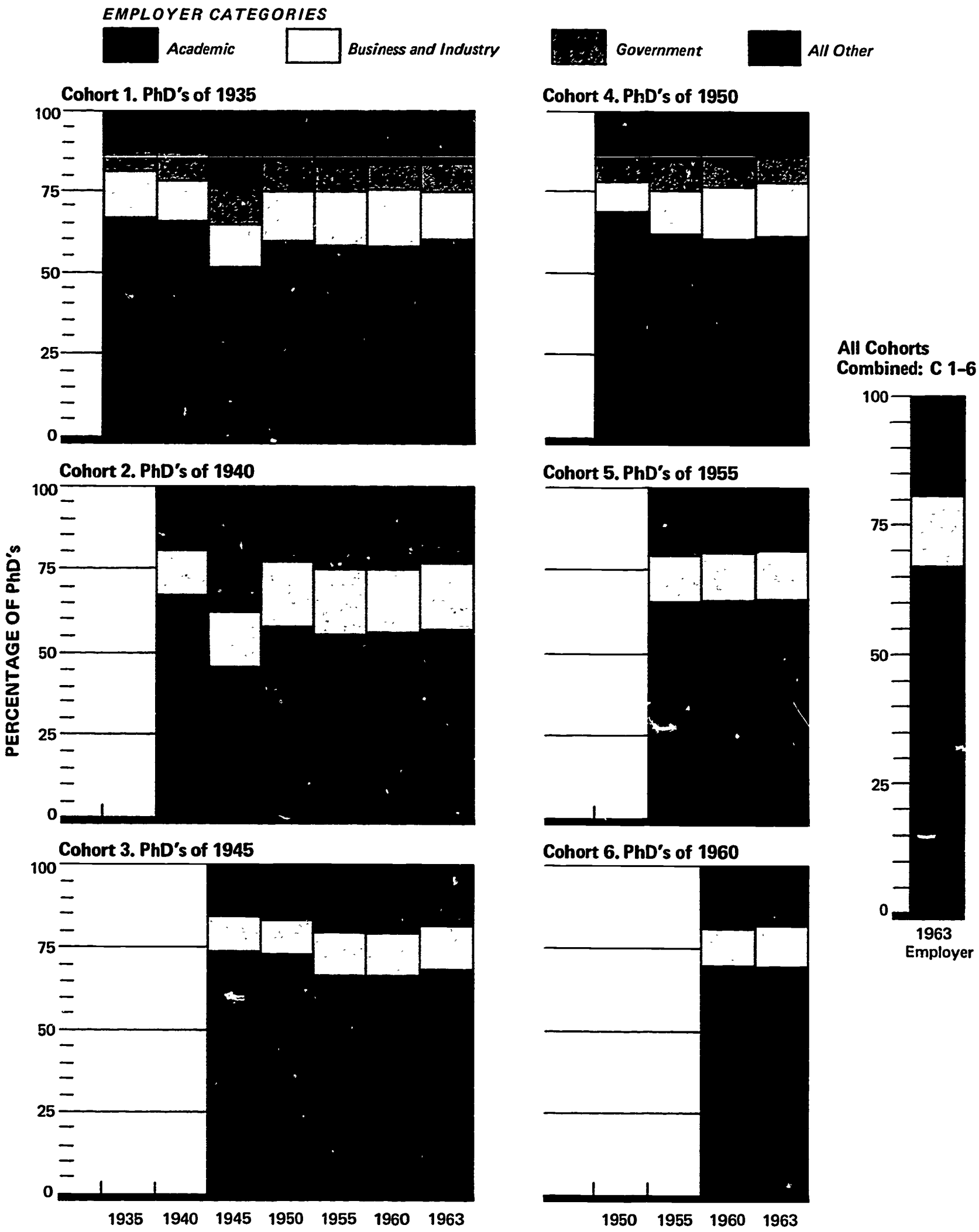
TIME TRENDS

For the 1935 graduates (Cohort 1), following the end of World War II, there was an exodus from both military and civilian service of the government into academic employment in 1950, and thereafter there was little gross change in the employer categories. The experience of the 1940 graduates (Cohort 2) was somewhat different, in that the business-and-industry segment of the economy absorbed

*Academic employers include U.S. and foreign universities and colleges; "government" means civilian employment by the U.S. Federal Government; "business and industry" refers to U.S. employment only; and "all other" includes self-employed, nonprofit, U.S. military, foreign (except university), state and local government, including schools, and unemployed.

FIGURE 1

Percentage of PhD's in Six Cohorts by Employer Category at Five-Year Intervals Following PhD Graduation



a much larger proportion of this group than of any other cohort, and this proportion grew consistently from 1940 through 1955, when it became stabilized. The 1945 graduates (Cohort 3) were unusual in their subsequent experience, perhaps due to the fact that the great expansion of higher education following World War II came just in time to involve this group maximally in academic activities. An unusually high proportion went to work immediately in colleges and universities, and this proportion has remained higher than for either earlier or later cohorts at similar stages in their careers. The 1950 graduates (Cohort 4) experienced an increasing degree of employment in business and industry through the first 15 years of their postdoctoral careers, as did graduates of 10 years earlier. The careers of the 1955 and 1960 cohorts are too brief to show a great deal in the way of patterns through the period available for study here.

The percentage in academic employment at each point in time from graduation through 1963 is given in Table 1 and is depicted graphically in Figure 2, the

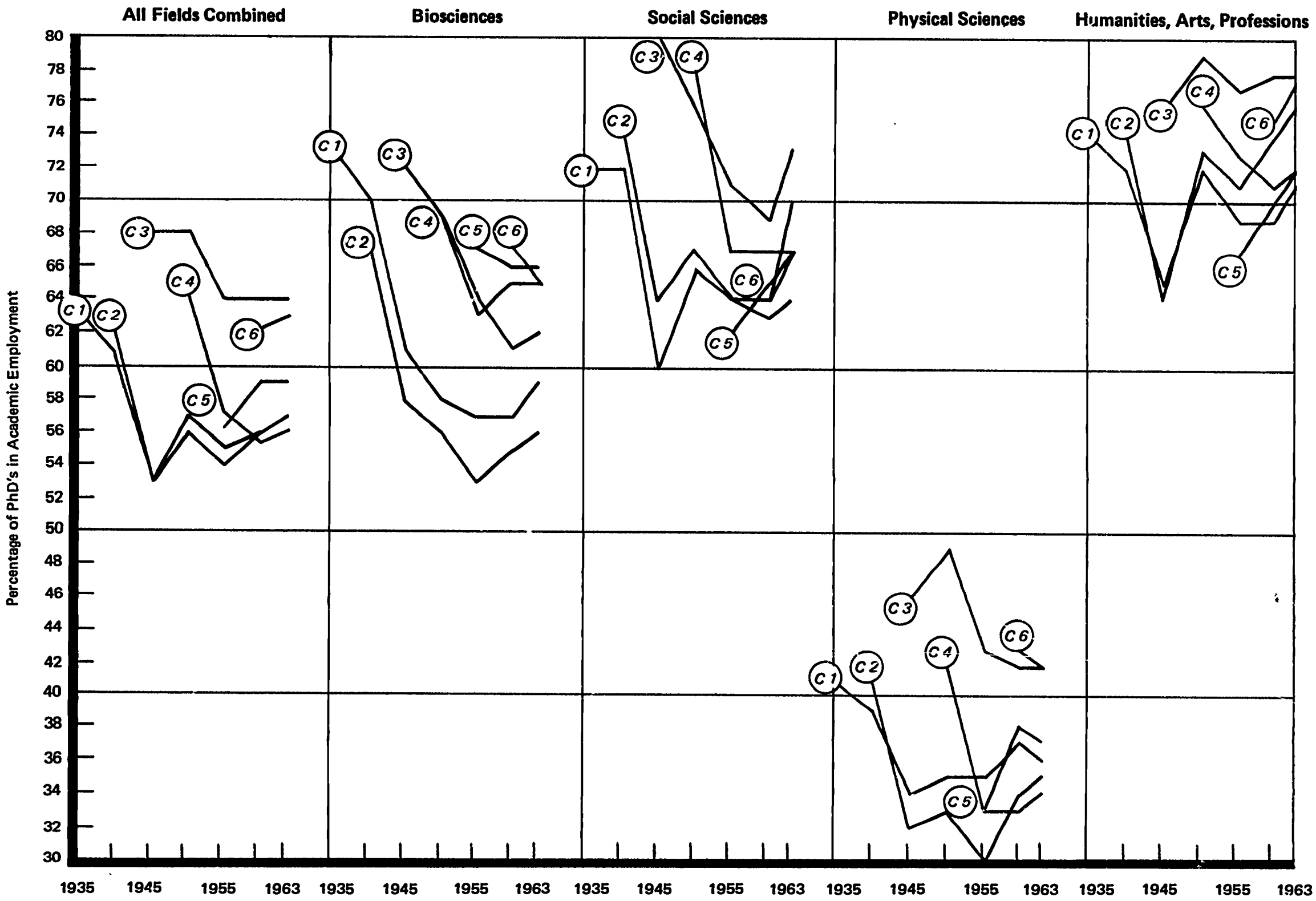
TABLE 1

Percentage in Academic Employment at Each Interval from PhD Graduation to 1963, by Cohort and Field

		PHD'S IN ACADEMIC EMPLOYMENT IN EACH REPORT YEAR (%)						
COHORT	FIELD	1935	1940	1945	1950	1955	1960	1963
1	TOTAL	63	61	53	57	55	56	57
	Biosciences	73	70	61	58	57	57	59
	Social Sciences	72	72	60	66	64	64	67
	Physical Sciences	41	39	34	35	35	37	36
	Humanities, Arts, Professions	74	72	65	72	69	69	71
2	TOTAL		62	53	56	54	56	57
	Biosciences		67	58	56	53	55	56
	Social Sciences		74	64	67	64	63	64
	Physical Sciences		41	32	33	30	34	35
	Humanities, Arts, Professions		74	64	73	71	74	76
3	TOTAL		68	68	64	64	64	
	Biosciences		72	69	63	65	65	
	Social Sciences		80	76	71	69	73	
	Physical Sciences		46	49	43	42	42	
	Humanities, Arts, Professions		76	79	77	78	78	
4	TOTAL			64	57	55	56	
	Biosciences			69	64	61	62	
	Social Sciences			78	67	67	67	
	Physical Sciences			42	33	33	34	
	Humanities, Arts, Professions			76	73	71	71	
5	TOTAL				56	59	59	
	Biosciences				67	66	66	
	Social Sciences				62	65	67	
	Physical Sciences				33	38	37	
	Humanities, Arts, Professions				67	70	72	
6	TOTAL					62	63	
	Biosciences					67	65	
	Social Sciences					64	70	
	Physical Sciences					43	42	
	Humanities, Arts, Professions					75	78	

FIGURE 2

Percentage of PhD's in Academic Employment from Graduation to 1963, by Cohort and Field



first portion of which recapitulates the data of Figure 1, but in a different form. The total of all fields is given at the left, and the four general fields of biosciences, social sciences, physical sciences, and humanities, arts, and professions combined are given successively across the page. Looking first at the total of all fields, a comparison of cohorts is useful. Cohorts 1 and 2, the graduates of 1935 and 1940, started off with over 60% in academic employment, but this percentage dropped sharply during World War II, to about 54% in 1945, and has remained in that neighborhood since, with minor fluctuations. Cohort 3, however, graduating just at the end of the war, when the "GI bulge" was just beginning, was heavily engaged in academic work from the beginning, although the percentage dropped from 68% to 64% over the 1950–1955 period. Cohort 4, graduating in 1950, was still heavily employed in academic work at first but dropped quickly to the level of Cohorts 1 and 2. Cohort 5, graduating in 1955 when college and university growth was on a temporary plateau, started out at 56% academic and increased to 59% five years later. Cohort 6, graduating in 1960, reflected a new upsurge in higher education that is indicated by minor but fairly consistent rises in academic employment by all cohorts during the late 1950's and early 1960's.

The major trends for the all-field total apply to each field separately, but there are differences in detail. In the biosciences, the discontinuity between Cohorts 2 and 3 is quite evident, but the downward trend from graduation to later employment is more pronounced than for all fields combined. Cohorts 1 and 2 did not experience a postwar return to academic work as did all the other fields. The prewar–postwar discontinuity is strikingly evident in the social sciences also, and Cohorts 1 and 2 showed a sharp upswing during the "GI" period. The rise from 1960 to 1963 is quite evident, particularly in the latest two cohorts. The physical sciences, while much more industrially oriented than the other fields, show the same wartime and postwar shifts but have decidedly mixed trends during recent years, those cohorts that were highest in academic employment (C 3, C 6) showing a drop, while those that were lowest rose in academic employment (C 2, C 4). The humanities, arts, professions group is, quite understandably, highest in academic employment and appears to be most responsive to trends in student population: a wartime drop, postwar rise followed by a mild recession, and then a new increase from 1955 through 1963.

Civilian to Soldier to Civilian

The experience of the same six graduation cohorts is shown in greater detail in Table 2, which gives the changes from one employer category to another at each interval from graduation to 1963. In this table, as in Figure 1, "other" means other than business, government, or academic employment. It shows the interchange between each of the four employer categories. The first set of three columns shows the flow out of academic life into business, government, and all other categories. The next set of three shows the flow from business and industry into academic, government, and other positions, respectively. The third set of columns shows the flow from government into academic, business, and other employment. The fourth set shows the flow from the miscellaneous "other" category into academic, business, and government jobs. The next column tabulates those people who were known to have changed employer category but who could not be accurately categorized because of missing or ambiguous data. The final four columns show the net change in each of the four employer categories, as a result of all the shifts described in the first twelve numerical columns. The experience of each graduation cohort is shown in successive sections down the page. The first section gives the experience of Cohort 1, by intervals from 1935 to 1963, one line per interval. Each succeeding section is one line shorter, because of the shorter careers. The movement from the academic employment into the military ("other" in this table) at the time of World War II is particularly prominent in the first two cohorts, and the later reverse movement is also apparent. For the 1945 period there was also a distinct movement from military

TABLE 2

Number of PhD's Shifting Employer Categories by Cohort and Time Period

COHORT	TIME PERIOD OF SHIFT	NUMBER OF PHD'S SHIFTING EMPLOYER CATEGORIES													NET CHANGE			
		ACADEMIC (A)			BUSINESS (B)			GOVERNMENT (G)			OTHER (O)							
		TO			TO			TO			TO			UN-				
		B	G	O	A	G	O	A	B	O	A	B	G	KNOWN	A	B	G	O
1	1935 to 1940	19	36	46	24	3	13	11	2	3	41	7	6	58	- 25	- 12	+29	+ 8
	1940 to 1945	37	51	143	11	5	12	9	6	16	26	6	6	54	- 185	+21	+31	+133
	1945 to 1950	16	16	34	20	3	8	30	13	17	120	10	24	36	+104	+ 8	- 17	- 95
	1950 to 1955	10	6	29	2	3	2	9	3	11	20	8	5	27	- 14	+14	- 9	+ 9
	1955 to 1960	7	2	20	7	2	4	5	2	7	19	4	6	26	+ 2	—	- 4	+ 2
	1960 to 1963	3	2	19	6	5	7	3	2	5	32	4	4	24	+ 17	- 9	+ 1	- 9
2	1940 to 1945	72	62	234	20	10	24	14	3	28	30	8	14	73	- 304	+29	+41	+234
	1945 to 1950	25	21	44	32	6	16	47	15	12	194	38	38	75	+183	+24	- 9	- 198
	1950 to 1955	24	22	41	13	—	10	10	10	6	22	11	10	48	- 42	+22	+ 6	+ 14
	1955 to 1960	8	11	24	16	3	15	15	10	10	23	7	5	37	+ 11	- 9	- 16	+ 14
	1960 to 1963	4	3	19	9	1	10	6	7	6	32	12	15	31	- 21	+ 3	—	- 24
3	1945 to 1950	32	25	60	34	6	4	25	1	15	49	5	7	39	- 9	- 6	- 3	+ 18
	1950 to 1955	27	20	54	6	1	7	6	7	8	21	7	5	40	- 68	+27	+ 5	+ 36
	1955 to 1960	12	8	29	8	5	6	7	2	5	34	6	5	33	—	+ 1	+ 4	- 5
	1960 to 1963	9	6	30	18	2	5	5	2	1	47	4	9	22	+ 25	- 10	+ 9	- 24
4	1950 to 1955	55	40	82	17	6	4	13	10	9	41	22	11	57	- 106	+60	+25	+ 21
	1955 to 1960	31	21	45	14	2	5	16	10	10	46	14	3	56	- 21	+34	- 10	- 3
	1960 to 1963	9	10	30	15	4	5	10	3	8	38	14	7	28	+ 14	+ 2	—	- 16
5	1955 to 1960	39	35	66	35	2	16	36	15	8	76	21	11	89	+ 7	+22	- 11	- 18
	1960 to 1963	13	22	35	18	3	9	10	3	9	45	8	15	84	+ 3	- 6	+18	- 15
6	1960 to 1963	42	27	62	30	6	7	28	11	5	69	14	19	30	- 4	+24	+ 8	- 28

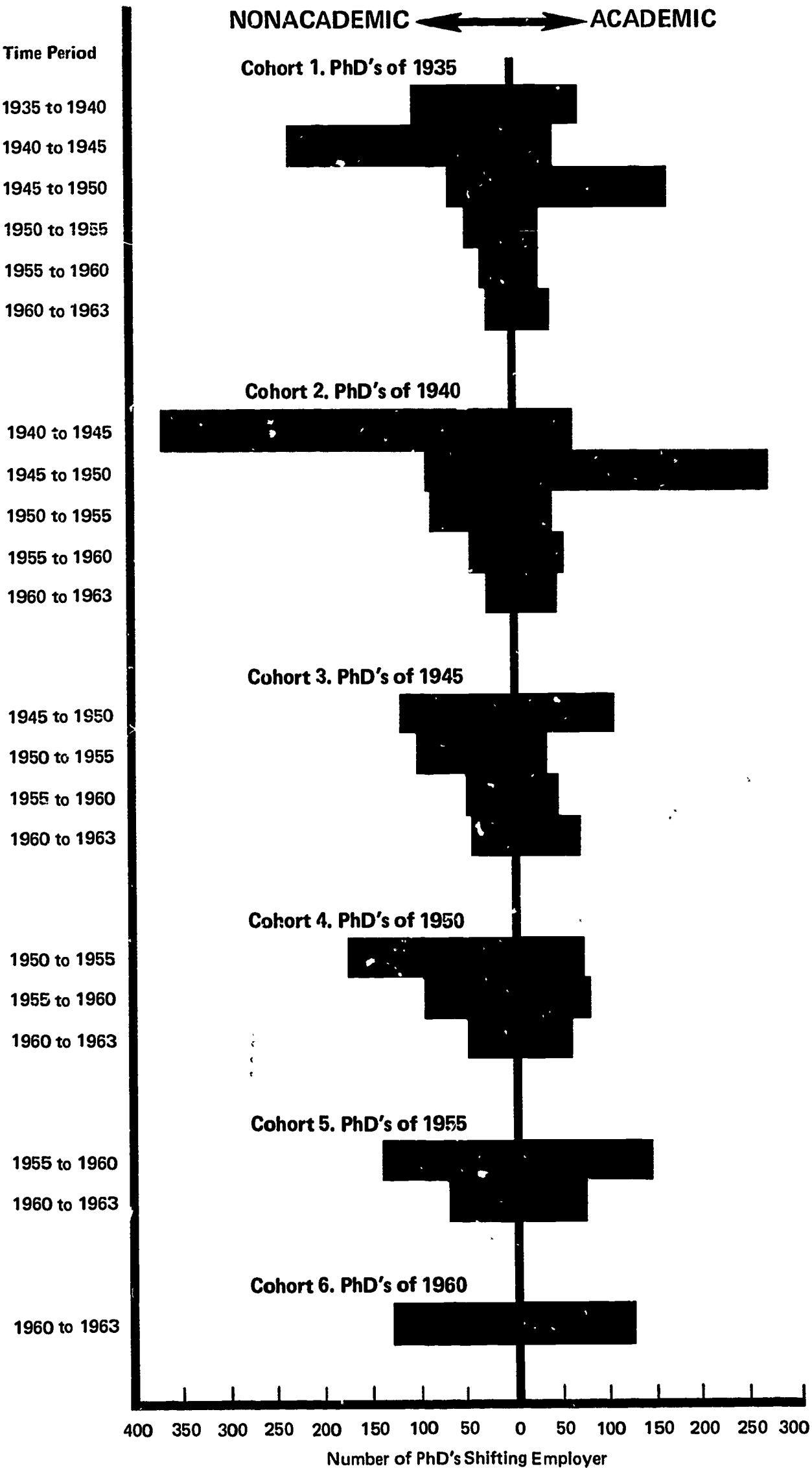
to civilian status within the government ("other" to government) for the 1935 and 1940 cohorts; and for the 1940 cohort, from military into business employment. The table also shows that the academic world in 1945–1950 drew from business and government, as well as from military service, to meet the demands for college and university teachers. The decreased shifting as careers mature is also clearly apparent in the diminishing net changes on successive lines within any one cohort.

CAREERS IN ACADEME— AND ELSEWHERE

The various nonacademic categories in Table 2 are combined for graphic simplification in Figure 3, which depicts the shifts between the academic and nonacademic worlds by cohort and time period. The shifts into the military and other governmental service during World War II, and the return to academe following that conflict are particularly dramatic. Another significant shift is that of Cohort 4. Attaining doctorates in 1950, when the "GI bulge" in colleges and universities was beginning to wane, this group tended to leave the academic halls in large numbers during the next five years, for both business and government positions.

Over the period with which this study is concerned, most of the holders of third-level research degrees found employment in academic institutions. Although the percentage employed in colleges and universities varies from field to field, this one employer category accounts for more people than all other

FIGURE 3
Number of PhD's Shifting between Academic and Non-academic Employment, by Cohort and Time Period.

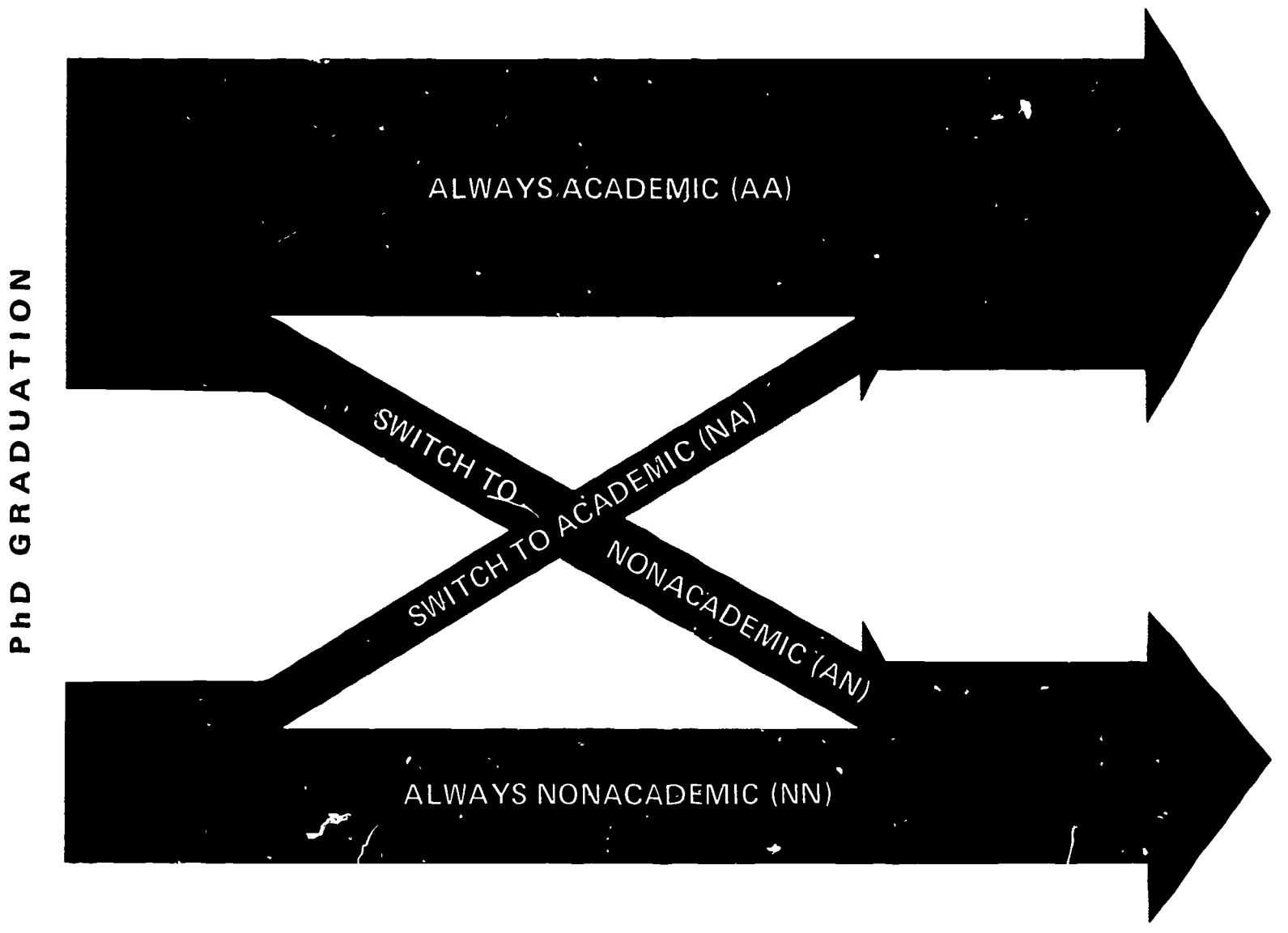


categories combined. The analysis of changes in employer category therefore tends to resolve itself into shifts into and out of the academic world. Shifts between other categories, such as government and business, may be of great importance for some groups and for certain types of questions. In the present study, however, the number of people available for analysis who made such shifts was too small, when the necessary controls for field, graduation cohort, and time of shift were applied, to permit these more detailed analyses. The focus of the report, therefore, will be on career changes that move people into or out of academe. The careers of those who stay in one or the other of these categories serve as points of reference.

In the initial analysis, an attempt was made to distinguish six groups according to their employment experience following the doctorate. These were later reduced to four: (1) those who remained always in academic employment (group AA); (2) those who remained always in nonacademic employment (group NN); (3) those who started in nonacademic jobs and later shifted to academic employment (group NA); and (4) those who started in academic jobs and later shifted to the nonacademic world (group AN). Initially, the attempt was made to subdivide the latter two groups, to take account of those who made two or more shifts, from academic to nonacademic and back to academic; or the reverse, nonacademic to academic to nonacademic. It was found that these groups were too small for satisfactory analysis, and that besides they were not greatly different from the groups with which they were finally combined. The final decision, then, was made on the basis of the employer category on the 1963 job.

The four groups used throughout this report, which are described above, are depicted graphically in Figure 4, in which the width of the channels is pro-

FIGURE 4
Diagram of Four Groups by Employment Experience, All Cohorts Combined



portional to the number of people in each group. The actual number of individuals in each of these channels is given later in Table 3, which also shows the details by field and cohort and, in addition, how many switched employer categories at any particular time.

It is these four groups that form the basis for analysis throughout this report. These same four groups will be used for the various fields and graduation cohorts. For certain analyses, it will be necessary to subdivide the "switch groups" (NA and AN) according to the time at which they switched from N to A or A to N, so that the factors related to such a switch can be examined. However, the basic pattern of the present study is reflected in the diagram of Figure 4. Groups AA and NN will furnish a background against which the groups NA and AN will be examined for light on factors involved in these career changes.

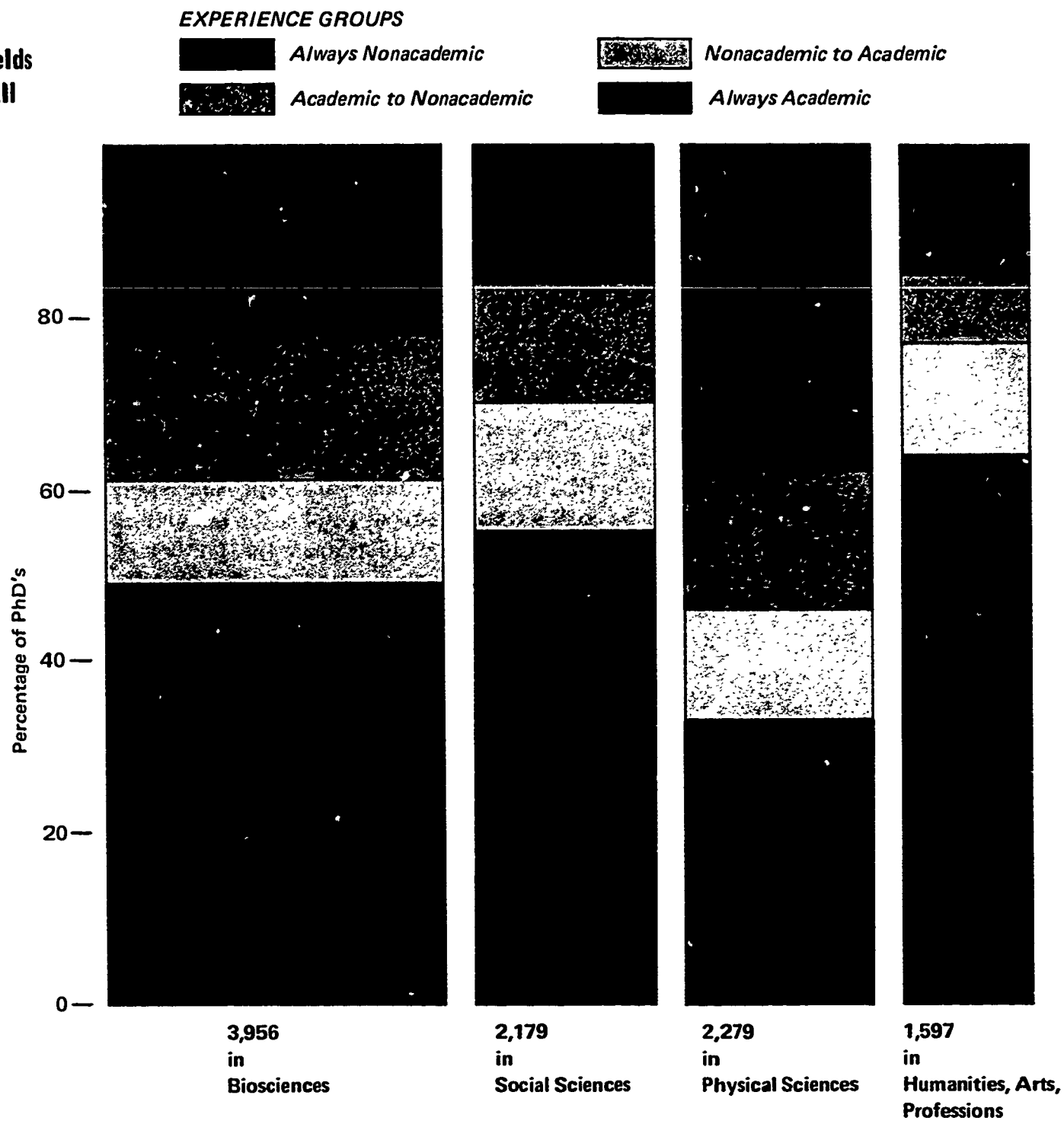
Four Field Groups

Although 10,000 careers seems to be a very large number, for the purposes of the kind of analyses attempted in this report, it is a very minimal number. The reason is that these 10,000 careers represent many different fields of specialization as well as six different graduation cohorts, each subdivided as outlined above and, for the most crucial analysis, further subdivided according to the time at which a switch was made from academic to nonacademic employment or vice versa. Under these circumstances, it was necessary to make certain combinations of groups which would be large enough for reliable statistical results to emerge but sufficiently homogeneous so that the results would also have real meaning for those who sought to interpret them. The first decision, then, was that regarding fields of specialization. It was decided that the greatest utility for the purposes of this report would be achieved by using four groups: the biosciences; the social and behavioral sciences (termed social sciences for short); the physical sciences (including mathematics, physics, chemistry, geology, and engineering); and the humanities, arts, and professions group, including education. This latter group, the most heterogeneous, was also the one with the sparsest sampling, resulting in the greatest difficulties of interpretation. Its components do have certain characteristics in common, however, in addition to being the "nonscience" group, and these characteristics will be dealt with at appropriate places in the analysis of the data.

Figure 5 (based on Table 3) gives a visual picture of the proportions of the total group of 10,000 cases represented by each of the four general fields and the four experience groups. The first column in this graph represents the biosciences, the second the social sciences, the third the physical sciences, and the fourth the humanities, arts, and professions. The preponderance of the biological sciences group is immediately apparent. This preponderance was a result of the interest in health-related sciences on the part of the sponsor of the study, the National Institutes of Health. Detailed breakouts within the bioscience fields were needed; this degree of detail was not required for the other fields. It will be remembered, however, that the weighting factors used in data calculation correct for this imbalance, so that figures for the group as a whole will accurately represent the general mix of the four groups as they were found in the several graduation cohorts. And within each group, the subgroups, although not here broken out for analysis, achieve their due weight in the whole. In fact, because the weighting factors are applied to each individual, every subgroup also achieves its due weight in any kind of summation. It might be noted, too, that these weighting factors, which do not appear in the calculations but were taken into account by the computer, result in combinations of mean values in the tables that do not necessarily agree with hand calculations from the data given in the tables.

Each of the four columns in Figure 5 is again broken down into the four career experience groups illustrated by Figure 4. As might be expected, these four experience groups are not present in the same proportions in the four fields. The biosciences group comes very close to the average for all fields combined, in part because it is such a large proportion of the total. In the social sciences,

FIGURE 5
Proportions in Various Fields and Experience Groups, All Cohorts Combined



and even more in the humanities, arts, professions group, the AA group is larger than it is in the biosciences, while in the physical sciences field it is smaller. In the latter, the never-academic (NN) group is particularly large, primarily because of the heavy employment of chemists and engineers in private industry.

The whole group of 10,011 cases, broken out by field, by cohort, and by career experience group, is shown in Table 3. In comparing with the previous report, it will be noted that some cases included there are omitted here. This is because certain items of information were either absent or too ambiguous to permit analysis. In the various tables that follow in this report, smaller numbers of cases may be found, for similar reasons. For example, if a certain datum in one period is being compared with that of another period, the data must be present in both periods to permit analysis. It is such requirements as these which cut down the number of available cases in many subsequent tables.

The total number of cases is shown at the top of the first data column on the first page of Table 3. In the top half of this table, the 10,011 cases are broken out in the column below into 4,908 who were always in academic employment, 1,311 who started in nonacademic employment and moved to academic work in various subsequent periods, 2,347 who were never in academic employment, and 1,445 who began their careers in the academic world and later, at the times shown, moved to nonacademic jobs. Each of these categories is broken out by field in the four columns to the right of the all-field summary column.

TABLE 3

Number of PhD's in Four Experience Groups by Field and Cohort

PHD COHORT	EXPERIENCE GROUP	TIME PERIOD OF SHIFT	TOTAL ALL FIELDS	NUMBER OF PHD'S BY FIELD			
				BIOSCIENCES	SOCIAL SCIENCES	PHYSICAL SCIENCES	HUMANITIES, ARTS, PROFESSIONS
1935-1960	**TOTAL**		**10,011**	**3,956**	**2,179**	**2,279**	**1,597**
	Always Academic	Never	4,908	1,940	1,189	749	1,030
	Nonacademic	**TOTAL**	**1,311**	**465**	**338**	**305**	**203**
	to	**1935 to 1940**	**48**	**18**	**13**	**11**	**6**
	Academic	**1940 to 1945**	**98**	**39**	**20**	**24**	**15**
		1945 to 1950	**241**	**65**	**67**	**68**	**41**
		1950 to 1955	**142**	**47**	**37**	**37**	**21**
		1955 to 1960	**322**	**130**	**76**	**75**	**41**
		1960 to 1963	**412**	**154**	**113**	**83**	**62**
		Unknown	**48**	**12**	**12**	**7**	**17**
	Always Nonacademic	Never	2,347	892	349	871	235
	Academic	**TOTAL**	**1,445**	**659**	**303**	**354**	**129**
	to	**1935 to 1940**	**59**	**33**	**7**	**15**	**4**
	Nonacademic	**1940 to 1945**	**236**	**113**	**51**	**57**	**15**
		1945 to 1950	**181**	**84**	**38**	**48**	**11**
		1950 to 1955	**296**	**106**	**83**	**86**	**21**
		1955 to 1960	**270**	**134**	**54**	**62**	**20**
		1960 to 1963	**341**	**159**	**55**	**76**	**51**
		Unknown	**62**	**30**	**15**	**10**	**7**
1935	**TOTAL**		**1,355**	**468**	**315**	**346**	**226**
	Always Academic	Never	534	194	122	98	120
	Nonacademic	**TOTAL**	**265**	**68**	**88**	**63**	**46**
	to	**1935 to 1940**	**48**	**18**	**13**	**11**	**6**
	Academic	**1940 to 1945**	**37**	**9**	**9**	**11**	**8**
		1945 to 1950	**73**	**12**	**31**	**20**	**10**
		1950 to 1955	**28**	**6**	**9**	**10**	**3**
		1955 to 1960	**27**	**7**	**8**	**6**	**6**
		1960 to 1963	**40**	**13**	**15**	**4**	**8**
		Unknown	**12**	**3**	**3**	**1**	**5**
	Always Nonacademic	Never	274	78	45	119	32
	Academic	**TOTAL**	**282**	**128**	**60**	**66**	**28**
	to	**1935 to 1940**	**59**	**33**	**7**	**15**	**4**
	Nonacademic	**1940 to 1945**	**88**	**44**	**18**	**18**	**8**
		1945 to 1950	**46**	**21**	**12**	**10**	**3**
		1950 to 1955	**32**	**9**	**11**	**9**	**3**
		1955 to 1960	**17**	**7**	**4**	**5**	**1**
		1960 to 1963	**24**	**7**	**7**	**4**	**6**
		Unknown	**16**	**7**	**1**	**5**	**3**

TABLE 3
(continued)

PHD COHORT	EXPERIENCE GROUP	TIME PERIOD OF SHIFT	TOTAL ALL FIELDS	NUMBER OF PHD'S BY FIELD: BIOSCIENCES	SOCIAL SCIENCES	PHYSICAL SCIENCES	HUMANITIES, ARTS, PROFESSIONS
1940	**TOTAL**		**1,610**	**675**	**335**	**367**	**233**
	Always Academic	Never	598	235	143	97	123
	Nonacademic	**TOTAL**	306	126	64	63	53
	to	1940 to 1945	61	30	11	13	7
	Academic	1945 to 1950	102	31	25	26	20
		1950 to 1955	36	17	8	5	6
		1955 to 1960	47	22	7	12	6
		1960 to 1963	46	24	11	6	5
		Unknown	14	2	2	1	9
	Always Nonacademic	Never	348	132	53	135	28
1945	**TOTAL**		**1,289**	**419**	**333**	**296**	**241**
	Always Academic	Never	657	206	185	108	158
	Nonacademic	**TOTAL**	204	67	55	50	32
	to	1945 to 1950	66	22	11	22	11
	Academic	1950 to 1955	23	8	10	3	2
		1955 to 1960	43	18	13	7	5
		1960 to 1963	59	15	17	15	12
		Unknown	13	4	4	3	2
	Always Nonacademic	Never	207	66	33	75	33
1950	**TOTAL**		**1,626**	**558**	**362**	**435**	**271**
	Always Academic	Never	775	267	201	138	169
	Nonacademic	**TOTAL**	193	63	43	54	33
	to	1950 to 1955	55	16	10	19	10
	Academic	1955 to 1960	71	25	17	17	12
		1960 to 1963	62	21	15	16	10
		Unknown	5	1	1	2	1
	Always Nonacademic	Never	393	131	58	161	43

TABLE 3
(continued)

PHD COHORT	EXPERIENCE GROUP	TIME PERIOD OF SHIFT	TOTAL ALL FIELDS	NUMBER OF PHD'S BY FIELD: BIOSCIENCES	SOCIAL SCIENCES	PHYSICAL SCIENCES	HUMANITIES, ARTS, PROFESSIONS
1955	**TOTAL**		**1,912**	**654**	**391**	**405**	**262**
	Always Academic	Never	1,003	454	238	127	184
	Nonacademic to Academic	TOTAL	216	94	51	49	22
		1955 to 1960	134	58	31	33	12
		1960 to 1963	78	34	18	16	10
		Unknown	4	2	2	—	—
	Always Nonacademic	Never	505	204	72	189	40
	Academic to Nonacademic	TOTAL	186	102	30	40	14
		1955 to 1960	106	64	16	22	4
		1960 to 1963	78	38	12	16	12
		Unknown	4	—	2	2	—
1960	**TOTAL**		**2,219**	**982**	**443**	**430**	**364**
	Always Academic	Never	1,341	584	300	181	276
	Nonacademic to Academic	1960 to 1963	127	47	37	26	17
	Always Nonacademic	Never	620	281	88	192	59
	Academic to Nonacademic	1960 to 1963	131	70	10	31	17

Patterns Vary by Cohort

The bottom half of the first page of Table 3 is arranged in the same fashion as the top portion, but refers only to the 1935 graduation cohort. On the subsequent pages, similar data are presented for the cohorts of 1940, 1945, 1950, 1955, and 1960. It will be noted, in examining this table, that the number of "switch groups" decreases with each successive cohort, because switches in employer category are considered only for the postdoctoral period. It will also be noted that for some people the exact period of switch from one employer category to another is unknown, or indeterminate, usually because the necessary data were missing for a particular period. The total of such "unknown" cases is only 110—a little more than 1% of the whole group, concentrated principally in the early cohorts.

When Do They Switch?

The lines of Table 3 most vital to this report are those showing the numbers of cases available in each of the "switch groups." That is, within each cohort, the people who switched from one employer category to another (groups NA and AN) are sorted out by the period within which the switch (or the latest switch, if more than one) occurred. The numbers in these switch groups are small, so that for certain analyses it will be necessary to combine cohorts in order to achieve a sufficient number of cases. Where more than one switch occurred, it is the most recent one that forms the basis for group designation, so that the switch groups NA and AN represent, respectively, people who at the latest data collection point were in academic (A) or nonacademic (N) employment. Two cohort groups will be used, representing, respectively, the education pattern predominantly pre-World War II (Cohorts 1, 2, and 3) and the postwar education

pattern (Cohorts 4, 5, and 6). These combinations will be designated Cohorts 7 and 8 where abbreviation is necessary. In a later chapter that deals with women only, this becomes even more important, as the women constitute only about 10% of the entire group.

It is apparent from this description of groups, and from Table 3, that we are dealing here with a very large number of separate groups. Taking the four fields, six cohorts, and four experience groups into account, and subdividing groups NA and AN into their appropriate switch groups, there are 216 distinct groups, before recombining them as may be necessary by field, by cohort, or otherwise for various purposes of analysis and interpretation.

Nature or Nurture?

A number of important questions can be explored by examination of the differences between and among these various experience groups. One might ask, first, whether the differences that are found are attributable to initial differences in the individuals themselves or are matters of circumstance or of developments during or after graduate education. If it were to be discovered that there were significant variations among the experience groups in background, such as education of parents, father's occupation, age at graduation from high school or from college, size or type of high school, honors won as an undergraduate or graduate student, or pattern of support during graduate education, then it might be difficult to interpret the factors immediately related to change in employer category. Perhaps income differential would be more important for a person from an impecunious family background; perhaps status on the academic ladder would be more important for one who came from a professor's family. Many such complications could be imagined, and they would be difficult to test in the present study because of the limited number of cases that could be brought to bear on any particular question. On the other hand, if the 216 subgroups were either homogeneous with regard to background factors, or varied randomly according to sampling expectations rather than systematically, then one could ignore the background variations and focus attention solely on the more proximal conditions—those characteristics of the immediate situation that were associated with change in employer category.

Random Differences Only

The investigation of the variations among the 216 subgroups with regard to a variety of background factors involved some rather complex considerations, which are explained in some detail in Appendix B. It will suffice here merely to note that, after an extensive investigation of the possible relationship of various predoctoral factors to experience group, it was found that none of them, except support of graduate education, related significantly. Variations among the subgroups with regard to a list of eight predoctoral variables were only such as might be expected on a purely random-sampling basis with groups of the sizes found here. These eight variables were as follows: age at high school graduation, BA, and PhD, honors as undergraduate and as graduate student, education of father and of mother, and high school class size. This confirmed in a way the finding of the earlier report, Profiles of Ph.D's in the Sciences, that showed no significant relationships between a number of background factors and category of employer in 1963. This negative finding cleared the way for an examination of the factors more immediately associated with change in employer category. Although in individual cases the predoctoral factors might have been important, in the groups examined here they would operate randomly only, and so perhaps attenuate the more immediate relationships but not systematically invalidate them.

SUMMARY OF CHAPTER I

Data were collected on the careers of 10,000 PhD's via a questionnaire mailed to a carefully stratified sample of people selected from the graduation cohorts of 1935, 1940, 1945, 1950, 1955, and 1960. This sample was heavily weighted toward the biosciences because of the special interest in this group on the part of the sponsor, the National Institutes of Health. Weighting factors were developed to permit a weight to be assigned to each respondent, in order to reproduce faithfully the original base population from which these cases were drawn.

The present study focuses on the factors related to a shift from or to academic employment. All other categories of employers were lumped in this study, for the sake of simplicity and the need to focus on a single issue. For this purpose, the careers have been categorized into four groups: those always in academic employment, those shifting from academic to nonacademic jobs, those shifting from nonacademic to academic jobs, and those always in nonacademic positions. Tables have been provided to show the number of people in each of these groups, by field and graduation cohort and by the point in time at which a shift occurred, for those not always in either academic or nonacademic employment.

An examination of predoctoral factors related to the academic versus nonacademic career pattern shows that there are random differences only among the four career groups. The sole possible exception concerns support for graduate education, which is examined in detail in Chapter III. Appendix B provides a description of the techniques used in examining group differences in a large number of other predoctoral factors, none of which were significantly related to subsequent career choice.

CHAPTER II RANK AND SALARY

THE ACADEMIC LADDER

If one looks at the variety of variables available, among all those related to the immediate occupational situation, to determine which among them might be causally related to change in employer category, it is apparent that there are several that need to be carefully considered. Most of the people in this study are in academic jobs; for them the opportunity to progress up the academic ladder is important. Academic rank was therefore carefully explored, even though there is no directly comparable scale for the nonacademic people. It was hoped that, with a scale based on those always in academic jobs, the importance of rank in shifting into and out of academic jobs could be determined. A great deal of interesting information about academic ranks was discovered, and it is described below, chiefly for its own intrinsic value, even though it is of limited utility in delineating reasons for switching into or out of academe.

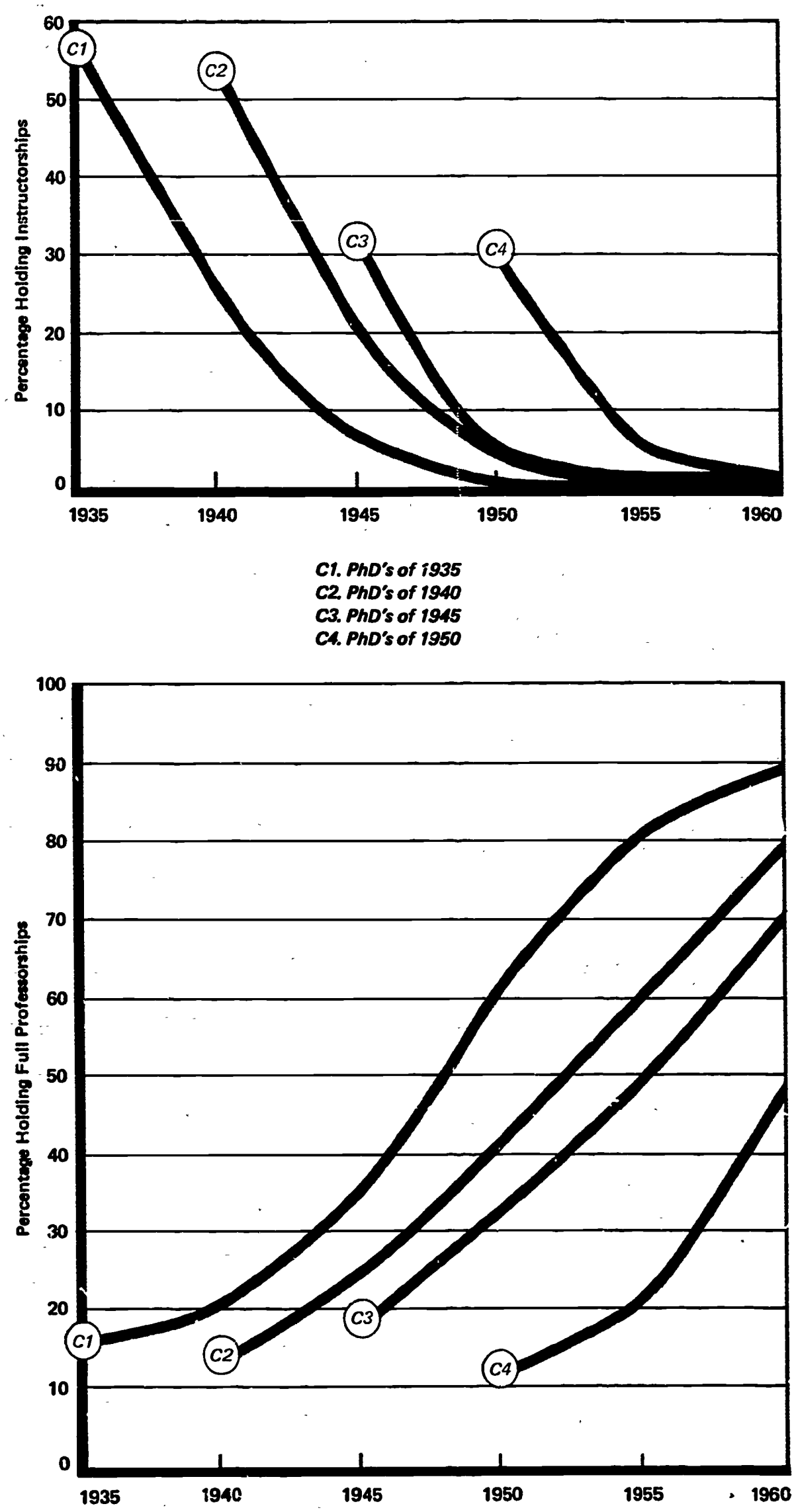
It must be acknowledged that the academic ladder is not a perfect scale, as the ranks of instructor, assistant professor, associate professor, and full professor vary in significance according to the institution at which the individual is employed. An associate professorship at one of the leading universities is worth more, in both prestige and remuneration, than a full professorship at many a minor college. This limitation notwithstanding, this progression does form a generally recognized metric. Furthermore, when groups of people from many institutions are combined, as they are in the present study, the institutional variations in significance of academic rank largely cancel each other out. Under these circumstances, the academic ladder forms a scale that can be reasonably used to compare groups of cases.

The general rate of attainment of the various academic ranks proved quite instructive, both as to field variations and as to changes over time in the significance of the various academic ranks. One important time trend is illustrated by the graphs in the upper half of Figure 6, which show the movement out of the rank of instructor by four different graduation cohorts. This figure, the data for which are drawn from Table 4, combines all fields, and thus averages a trend which is stronger in the physical sciences than in the other fields, viz., the gradual diminution of the instructorship as the first step in the academic ladder. A computer malfunction unfortunately caused the loss of the data for the 1955 cohort, but, as Table 4 shows for the 1960 cohort, the skipping of the instructor rank is a continuing trend. The time lapse before promotion to assistant professor also appears to be decreasing, as might be expected when initial appointments as assistant professor are common.

Of Uniforms and Uniformity

Progress to the final step of the academic ladder—full professorship—is illustrated by the bottom portion of Figure 6. The variation from one cohort to the next is not a steady progression of changes, as can be seen on a field-by-field basis in Table 4. The variations can be related to World War II and its aftermath. Some in Cohort 1 went into military service, though most remained in academic life throughout the war. (Those who left for government civilian jobs

FIGURE 6
Percentages of Always-Academic Group at Instructor and Full-Professor Ranks by Cohort and Year, All Fields Combined



C1. PhD's of 1935
C2. PhD's of 1940
C3. PhD's of 1945
C4. PhD's of 1950

TABLE 4

Percentage of Always-Academic Group by Academic Rank at Five-Year Intervals Following PhD Graduation, by Field and Cohort

		PERCENTAGE OF PHD'S BY COHORT AT FIVE-YEAR INTERVALS AFTER GRADUATION										
		IMMEDIATELY AFTER PHD						5 YEARS LATER				
FIELD	ACADEMIC RANK	C 1	C 2	C 3	C 4	C 6	TOTAL OF COHORTS 1-6	C 1	C 2	C 3	C 4	TOTAL OF COHORTS 1-4
TOTAL	Prof	16	14	19	12	7	10	20	25	33	21	25
	Assoc	8	9	17	11	16	12	17	19	27	35	25
	Asst	19	23	32	46	53	41	38	36	36	39	37
	Instr	57	54	32	31	24	37	25	20	4	5	13
Biosciences	Prof	13	10	11	8	4	8	18	17	24	15	19
	Assoc	7	9	17	13	8	10	16	25	27	42	27
	Asst	17	26	38	51	60	42	40	41	41	38	40
	Instr	63	55	34	28	28	40	26	17	8	5	14
Social Sciences	Prof	15	18	18	9	3	10	17	26	35	18	24
	Assoc	6	7	11	11	12	10	24	27	32	43	31
	Asst	20	20	32	48	57	41	38	37	32	36	36
	Instr	59	55	39	32	28	39	21	10	1	3	9
Physical Sciences	Prof	13	3	9	5	5	6	16	14	18	12	15
	Assoc	13	6	13	10	9	10	18	8	30	37	23
	Asst	19	20	42	60	67	48	48	65	49	49	53
	Instr	55	71	36	25	19	36	18	13	3	2	9
Humanities, Arts, Professions	Prof	20	17	24	19	10	16	27	32	41	29	32
	Assoc	9	10	22	12	24	17	14	17	24	26	20
	Asst	19	26	28	36	45	34	31	24	31	38	31
	Instr	52	47	26	33	21	33	28	27	4	7	17

were by definition excluded from the always-academic group.) Cohort 2 was affected substantially, as shown in Figures 1 and 3. It will be recalled that an interruption for military service in World War II, followed by an immediate return to academic employment, did not eliminate a person from the always-academic group, by the definition that was adopted. The interruption nevertheless affected career progress, and the resulting delay in attaining full professorship is shown in the bottom portion of Figure 6 for Cohort 2. Immediately after World War II, there was a great demand for college teachers, and this probably accounts in large part for the fact that a drastically lower percentage of Cohort 3 began as instructors, and that they progressed with unusual speed to associate and even full professor levels. This same fact, however, should probably be expected to have a slowing effect on the progress of other cohorts a few years later, as the higher ranks would tend to be filled with relatively young men. The curves for Cohort 4 indicate that this is probably what occurred. Cohort 4 made less rapid progress to full professorship than had Cohort 3, and this is true in all four fields. A wave was thus induced in the rate-of-promotion data, and it is not unreasonable to expect that it would affect several academic generations, in a manner somewhat analogous to the population waves associated with World War II. Whether the latter, on reaching the college level, will induce another wave of rapid promotions, and, if so, whether its point of incidence would tend to enhance or cancel the wave induced directly by World War II, is a question which the data of this study cannot answer.

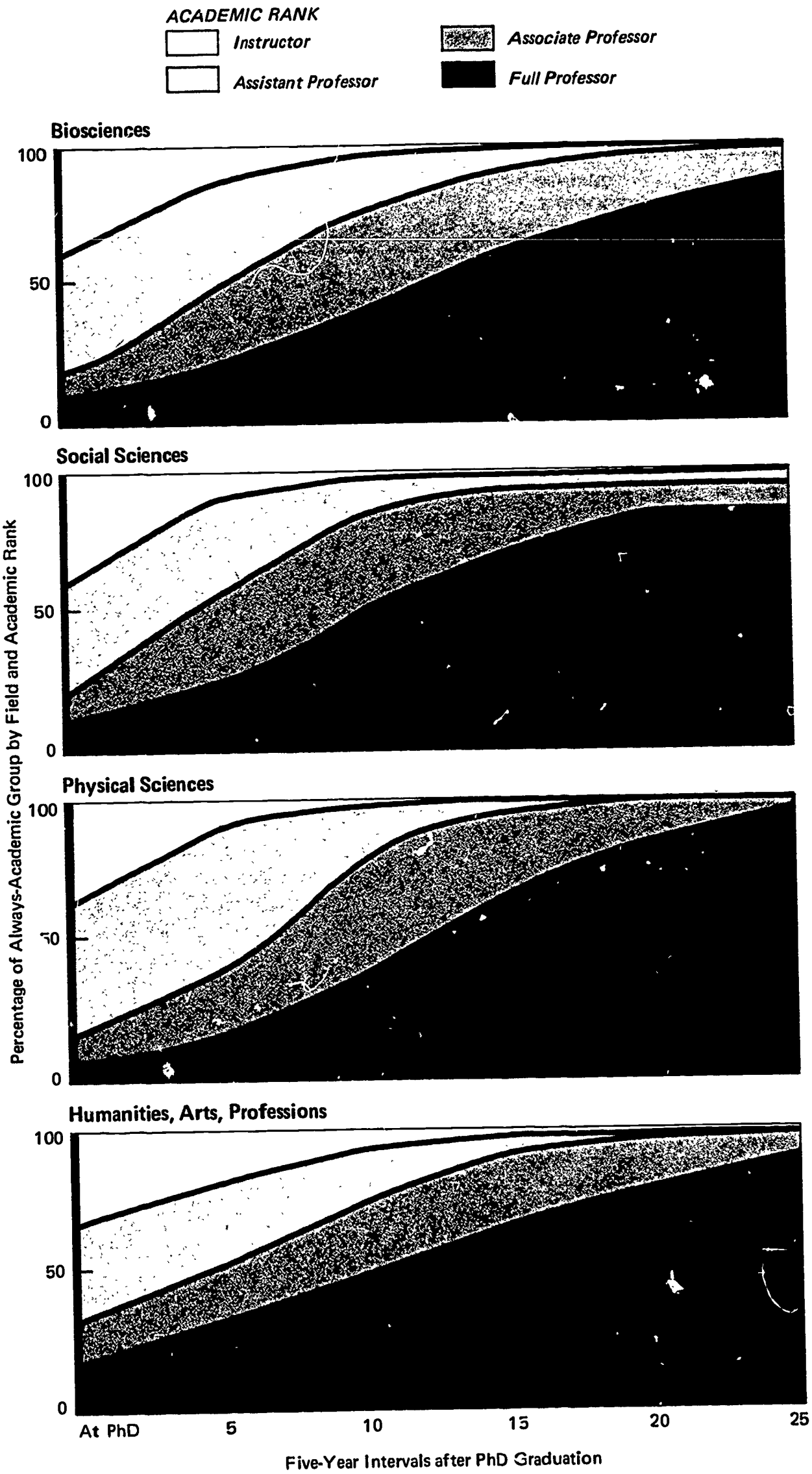
Table 4 provides the most comprehensive data with respect to the academic ladder, and the most significant data of Table 4, ignoring cohort differences, are

10 YEARS LATER					15 YEARS LATER				20 YEARS LATER			25 YEARS LATER		
C 1	C 2	C 3	C 4	TOTAL OF COHORTS 1-4	C 1	C 2	C 3	TOTAL OF COHORTS 1-3	C 1	C 2	TOTAL OF COHORTS 1+2	C 1	ACADEMIC RANK	FIELD
36	42	50	49	44	63	61	71	65	82	80	81	90	Prof	TOTAL
32	32	36	40	35	29	32	22	28	15	18	17	8	Assoc	
27	22	12	9	18	7	6	5	6	2	1	1	1	Asst	
5	4	2	2	3	1	1	2	1	1	1	1	1	Instr	
38	32	44	40	38	56	57	69	61	74	80	77	88	Prof	Biosciences
26	43	38	46	38	34	35	22	30	23	17	20	11	Assoc	
31	23	16	12	21	10	7	6	8	3	2	3	1	Asst	
5	2	2	2	3	—	1	3	1	—	1	—	—	Instr	
39	50	54	53	49	61	74	73	70	81	90	85	85	Prof	Social
31	36	36	40	36	31	20	22	24	12	8	10	10	Assoc	Sciences
28	13	9	6	14	7	6	4	5	6	2	4	5	Asst	
2	1	1	1	1	1	—	1	1	1	—	1	—	Instr	
29	26	38	50	36	73	53	69	65	92	79	85	97	Prof	Physical
50	41	49	46	47	26	45	26	32	8	21	15	3	Assoc	Sciences
18	31	12	4	16	1	2	5	3	—	—	—	—	Asst	
3	2	1	—	1	—	—	—	—	—	—	—	—	Instr	
38	47	56	52	48	66	58	72	66	82	76	79	92	Prof	Humanities,
28	20	30	34	28	25	34	22	27	15	22	19	7	Assoc	Arts,
27	24	11	11	18	8	7	4	6	2	1	1	—	Asst	Professions
7	9	3	3	6	1	1	2	1	1	1	1	1	Instr	

illustrated in Figure 7, which shows all four steps in the ladder simultaneously. Each field is illustrated separately, and progress over a quarter-century is shown. This progress, however, is the aggregate experience of several cohorts, and the full period of 25 years could, of course, include only Cohort 1, whereas all cohorts are included in the data for the immediate postdoctoral period. The experience of the older cohorts is thus progressively heavier for the periods beyond 10 years; at 5 years and 10 years after the doctorate, Cohorts 1, 2, 3, and 4 are included. Time trends thus exert different effects at different points in these graphs, with the result that the slopes as shown are not so steep as recent experience would indicate. They thus have a conservative bias, and, if they are used in a normative way, this negative bias should be understood.

Field variations in rate of progress up the academic ladder are marked, as is shown by Figure 7. Another phenomenon also illustrated by Figure 7 is field variation in the percentages of full professorships immediately after the doctorate. This is probably directly a function of age at receipt of the PhD degree and, secondarily, a function of the varying customs in the several fields. The physical scientists, with a very low percentage of full professors immediately after the doctorate, are mostly in their late 20's at graduation. Those in the humanities, arts, professions group are largely in their 30's; in education the median age at doctorate is close to 40. Thus the humanities, arts, professions group is in general at a more advanced career stage when the PhD degree is granted than are the physical scientists. In the latter group, uninterrupted education is much more the rule. The graphs in effect depict different career stages, in spite of having PhD degree attainment as a common starting point. The slopes

FIGURE 7
Progress of the Always-Academic Group: Rank at Five-Year Intervals after PhD Graduation, All Cohorts Combined



of the curves do not have precisely the same significance for all fields for this reason; the variations from field to field help to describe a difference that is recognized in many other ways. The physical scientists have the steepest slope, the humanities, arts, professions group the gentlest, and the biosciences and social sciences fall into intermediate positions.

As mentioned earlier, this exploration of the academic ladder was undertaken to try to find whether it would be useful in determining whether failure to make expected progress might be important in causing people to leave the academic life or whether the offer of a high rank might have been involved in inducing people to come into academic work from other fields. It turned out that it was not possible to use the data effectively for this purpose, although the data were suggestive. The problem was that those who switched into or out of academe frequently failed to indicate their academic rank at the crucial point. Blank records were found too often—in as many as half of the cases in one group—for those who switched in a particular time period. Inasmuch as the numbers of cases were minimal to begin with, even when all fields were combined, it was decided that it would be unwise to hazard an analysis based on such partial data, and the tables have been omitted as unreliable. The probability of selective omission of mention of the lower academic ranks makes it particularly hazardous to compare percentage distributions of the switch groups with those who remained in academe and seldom omitted data on rank. For all these reasons, and even though a scanning of the several cohorts indicated the good probability that those who left the academic halls were not making as rapid progress as did those who stayed, no further analyses of the data were attempted in this connection.

Another type of variable that was considered was time devoted to various types of duties, such as teaching, research, and administration. This was found to be interesting and was explored at some length. Yet this variable could not validly be used directly to compare the various experience groups, as percentage of time devoted to teaching is scarcely comparable across the academic and nonacademic groups. Because teaching necessarily precludes a certain amount of other activity, percentage of time devoted to research likewise could not be directly compared. Thus the inherent imbalance of functions across the academic–nonacademic line distorts interpretation although it does not prevent it entirely. The findings that were of interest in this connection are reported in some detail in Chapter III.

A third factor that might be expected to relate to change in employer category is change in geographic locale, although this might in most instances be interpreted as a consequence rather than a cause. It too is reported in Chapter III, as is change of field of specialization, which was also examined but found not to be useful as a factor causally related to change in employer category. Hours worked per week was likewise studied and is reported in Chapter III. The question of whether the chance to get away from the "standard 40-hour week" is an inducement to switch to academic work is left unresolved, but some interesting aspects were developed.

Finally, professional income was investigated, as the importance of income is universally recognized. Yet here, too, one must operate with awareness that varying provisions for fringe benefits are complications to a direct interpretation. In spite of all these limitations, the income variable has a considerable advantage as a point of departure in the study of variables related to change in employer category. Before proceeding to the analysis of results, some considerations with regard to income as a significant variable need first to be examined.

SALARIES

A Uniform Metric

"Money isn't everything, but it sure beats whatever is in second place." This ancient saw has relevance to the study of circumstances surrounding change of employer category, because money, in addition to correlating with all other relevant criteria, is the most readily manipulable and most understandable of measures. It furnishes a uniform metric that applied in all fields, to all cohorts, both sexes, all time periods and all employer categories. It is thus the most easily handled of statistical variables. It is also the variable most readily manipulated in an incentive system. Government influence in the field of graduate education is felt through funds for fellowships, for training grants, for research grants, and for institutional grants. The control of funds is thus the principal way by which government policy can be brought to bear in this field. It is also true that money is the variable most readily manipulated by university administrations or by business executives when incentive systems are being considered. Except in unusual circumstances, such as the construction of new buildings or the death or retirement of a staff member, the space in university or even industrial buildings cannot be manipulated readily; to move one person usually requires that another, or several others, also be moved. Furthermore, any such change in space is conspicuous and may arouse bad feelings on the part of others not similarly advantaged, while salary increases are usually a much more private matter. Other nonmonetary rewards have analogous limitations. It is no doubt for reasons such as these that salaries and rates of change in salaries tend to correlate with other indicators which would seem to be better or more direct criteria of scientific or scholarly accomplishment or merit. In any event, salaries do so correlate, they are readily examined measures and serve as a good starting place for consideration of conditions surrounding change in employer category.

Although salary data are objective and quantitative, they do have some characteristics that require special attention. One of the most obvious is that salary distributions do not follow the normal distribution curve—they are highly skewed. That is, there tends to be a piling-up in the below-average range and a spreading-out in the high range. Generally, this skewness can be taken care of rather well by transforming the raw data to logarithms: the salary data do follow rather well a log-normal distribution. When so transformed, however, the salary data are no longer recognizable in dollars, and it is necessary to retransform the mean of the logarithmic values back into dollars for interpretation. The resulting mean value is known as the geometric mean, as compared with the more usual arithmetic mean. Because it has the advantage of decreasing the undue influence of the few very high salaries, the geometric mean will be used throughout the salary data computations. For ordinary discussion purposes, this geometric mean will be used as if it were the more usual arithmetic mean, simply to reduce the complication of language. Tables 5, 6, and 9 and Figures 8, 9, and 11 employ this statistic.

Salary Increments Minimize Distortion

Salaries vary widely over time, as we are concerned here with a quarter-century of economic change. The value of the dollar has not remained constant but has gradually diminished. Salaries also vary from one field to another, and, in general, men's salaries are higher than women's salaries. All these sources of variation result in some difficulties in interpretation when different fields, the two sexes, and different time periods are concerned. Comparison of salary differentials when changing from one employer category to another is complicated by these sources of variation whenever one combines groups across time periods, cohorts, sexes, or fields. Fortunately, there is a relatively simple device that overcomes most of these difficulties rather neatly. One can simply compute, for each individual, the salary ratio from one time period to the next. For the purpose of examining career changes, each person thus becomes his own base of comparison. Salaries ordinarily increase over time; if the earlier salary is placed in the denominator, the quotient becomes a percentage gain in salary ex-

pressed as some value over 1.00. No change at all would be 1.00; decreases are indicated by values below 1.00. It may be noted here that these values are compounded, so that each successive year is a percentage of the previous year, rather than of a constant base period. These percentage change values can be averaged, and experience has shown that there is a minimal distortion when these average values are computed across time, sex, employer category, and field. We will, therefore, frequently refer to average annual increases and to variations in these rates of increase. Tables 10 and 11 and Figure 12 employ this statistic.

It will be useful, in addition to examining rates of increase from one time period to the next, to consider absolute values of salaries by field, by employer category, and by time period. It turns out that the most useful graphical device for viewing such changes is furnished by semilogarithmic paper, because of the fact that average annual rates of increase tend to be relatively constant. A constant rate of increase is plotted on such paper as a straight line, whereas it would be an upward curve if an arithmetic scale were used on the vertical axis. Variations in annual rates of increase appear as varying slopes of the lines; salaries that vary rather widely in absolute value but are similar in rate of increase can be readily compared on semilog paper: their graphs form parallel lines. It might be noted here that the average values to be compared in this way are geometric means, the means of the logarithmic values. The two techniques—graphic representation on semilog paper and geometric mean—therefore quite neatly supplement each other, to the end that a rather clear picture emerges of the changes in salary that are associated with various career changes.

The best starting point for consideration of salary variations and changes in rate of increase is perhaps furnished by consideration of the geometric mean of salaries of all fields combined, from one time period to the next, by each of the graduation cohorts involved in this study. This is shown in Table 5, which also gives data for individual fields, and by Figure 8. The latter is very similar to Figure 11 of Profiles of Ph.D's in the Sciences, the earlier report on these same people. It varies somewhat, however, as the values involved in the present computation are based on the weighted cases, to simulate the original population from which they were drawn. This was mentioned in the introduction and is explained more fully in Appendix A. The original numbers are frequently noted, as a caution in interpreting the percentages, means, and standard deviations, which were computed on a weighted basis. Suffice it to note that here, and throughout this report, wherever appropriate, it is these weighted values that are used, as a refinement over the technique of the earlier report. Where raw numbers are used, it is so stated in the table or figure. They are also used when statistical techniques, such as χ^2 or tests of significance, require them.

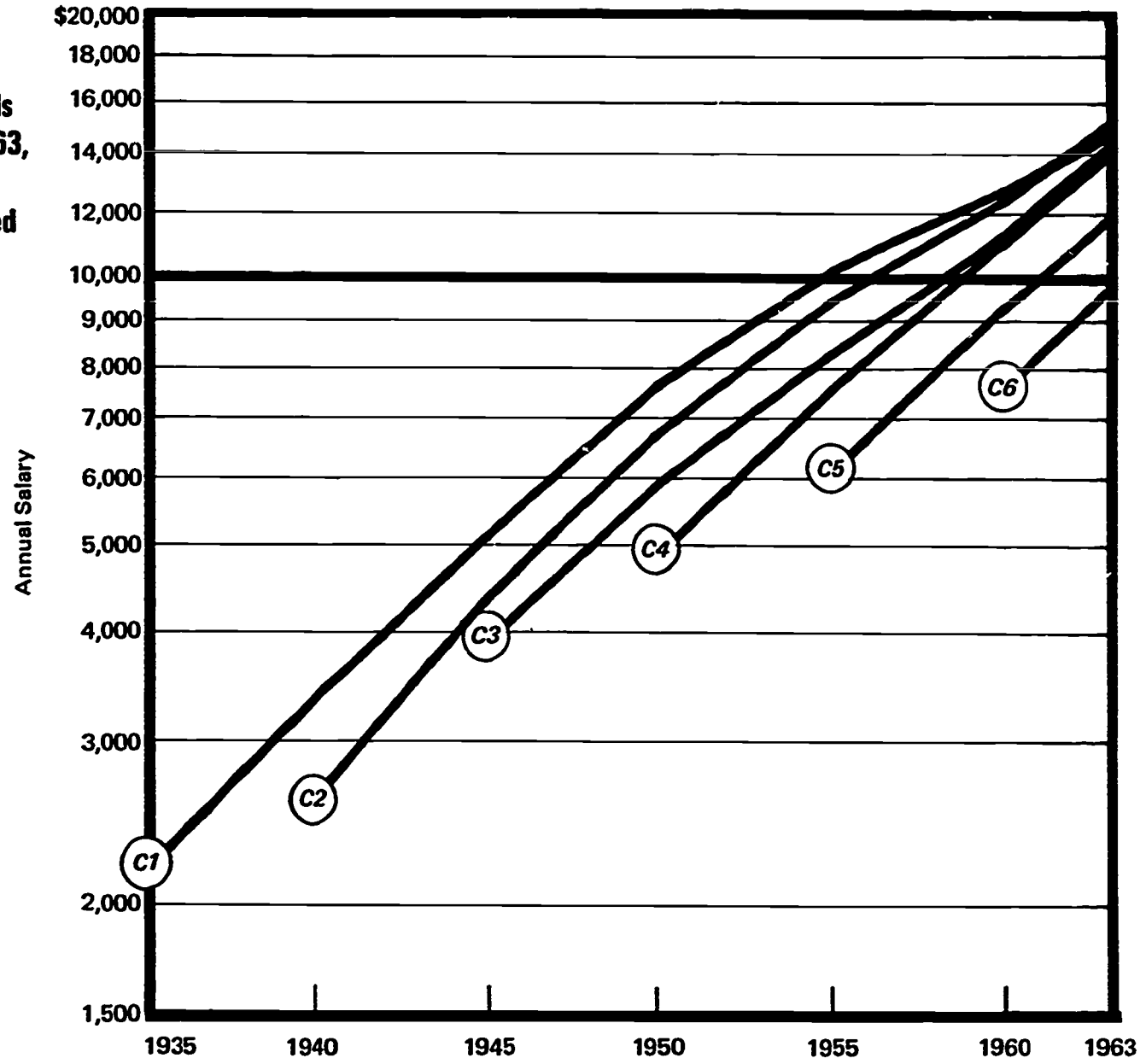
Another difficulty with the data of the earlier report is that they were based on varying numbers of cases at the various time periods. Some people did not report their incomes for all time periods. For this report, such incomplete cases are eliminated and the data recomputed on the bases of complete data cases only. For both these reasons, the two sets of data are slightly different, but the general trends are highly similar. The slopes of the curves in Figure 8 indicate an over-all salary growth of about 7% per annum, slightly less for the older cohorts and somewhat more for the later ones, so that the lines tend to converge as time goes on. These over-all growth curves are determined by many factors. To show the influence of each, these factors are sorted out to a degree in the following paragraphs.

TABLE 5

Geometric Mean of Annual Salaries from PhD Graduation to 1963, by Cohort and Field, All Experience Groups Combined

		ANNUAL SALARY BY YEAR						
COHORT	FIELD	1935	1940	1945	1950	1955	1960	1963
1	TOTAL	$2,210	$3,386	$5,066	$7,607	$10,071	$12,755	$14,906
	Biosciences	2,120	3,113	4,567	6,947	9,254	12,031	14,328
	Social Sciences	2,253	3,373	5,163	7,685	9,961	13,020	15,233
	Physical Sciences	2,065	3,406	5,667	8,805	12,084	15,007	16,978
	Humanities, Arts, Professions	2,427	3,606	4,750	6,828	8,756	10,859	12,978
2	TOTAL		2,615	4,436	6,748	9,477	12,519	15,171
	Biosciences		2,506	4,201	6,898	9,586	12,879	15,657
	Social Sciences		2,500	4,592	6,811	9,299	12,466	15,132
	Physical Sciences		2,614	4,842	7,761	10,794	15,160	18,105
	Humanities, Arts, Professions		2,766	4,108	5,719	8,312	10,087	12,386
3	TOTAL			3,921	5,972	8,317	11,492	14,408
	Biosciences			3,699	5,729	7,973	11,108	13,899
	Social Sciences			3,671	5,944	8,240	11,274	13,892
	Physical Sciences			4,133	6,523	9,641	13,615	16,866
	Humanities, Arts, Professions			4,027	5,670	7,518	10,200	13,080
4	TOTAL				4,975	7,648	11,240	14,138
	Biosciences				4,733	7,084	10,062	12,647
	Social Sciences				4,713	7,496	11,056	14,090
	Physical Sciences				5,395	8,683	13,255	16,399
	Humanities, Arts, Professions				4,811	6,925	9,879	12,566
5	TOTAL					6,062	9,235	11,976
	Biosciences					5,639	8,234	10,947
	Social Sciences					5,820	9,002	11,984
	Physical Sciences					6,727	11,054	14,063
	Humanities, Arts, Professions					5,930	8,501	10,817
6	TOTAL						7,614	9,723
	Biosciences						7,035	8,847
	Social Sciences						7,274	9,826
	Physical Sciences						8,432	10,774
	Humanities, Arts Professions						7,644	9,446

FIGURE 8
Geometric Mean of Annual Salaries at Five-Year Intervals from PhD Graduation to 1963, by Cohort, All Fields and Experience Groups Combined



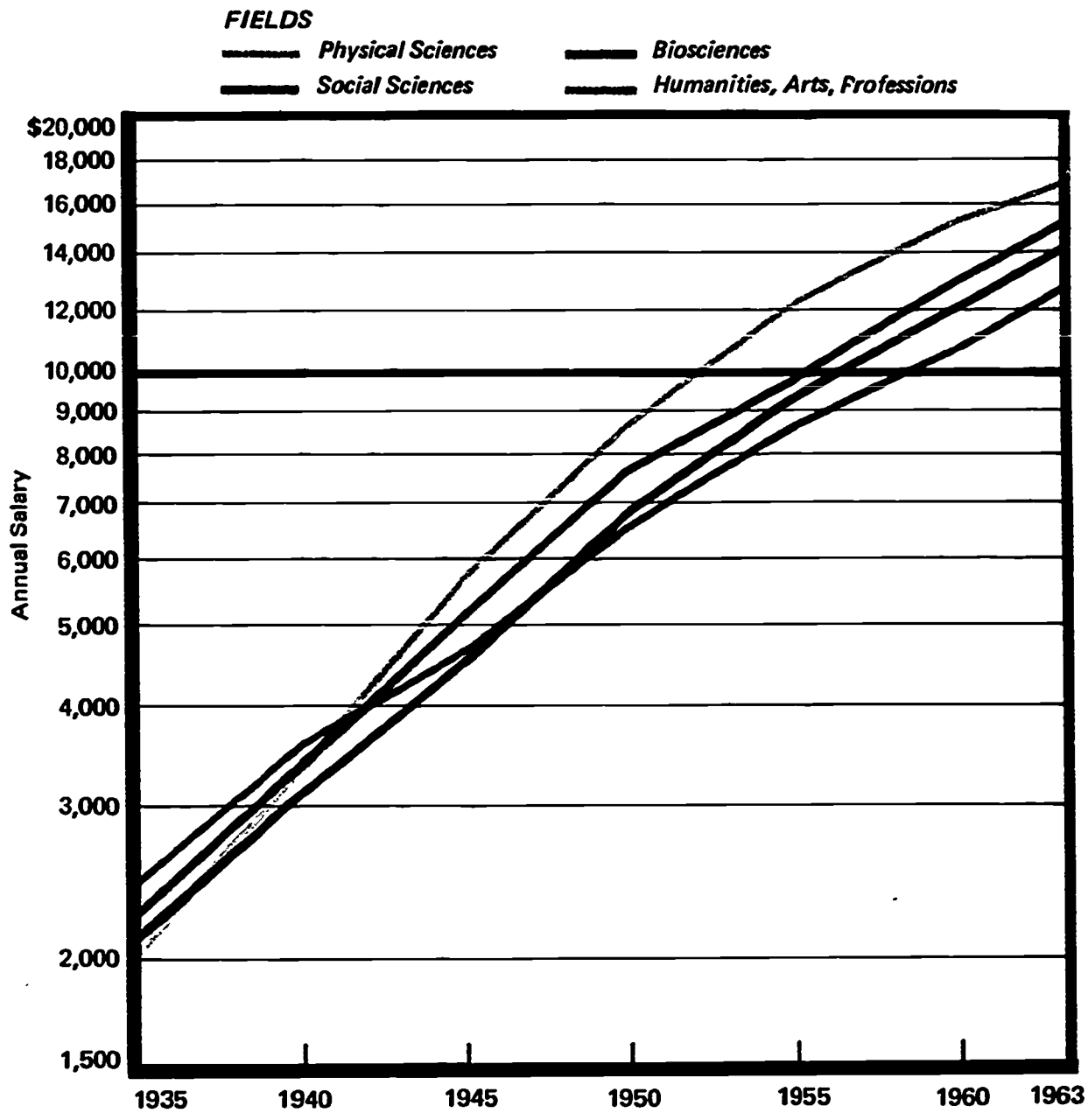
Field Variations in Salary

Salaries vary by field, and the field variations are given in Table 5 for each cohort and time period. Cohort 1, which provides the longest time series, is used to illustrate these field variations in Figure 9. Similar curves, but shorter ones, would be found for the other cohorts. The salary growth lines for the social sciences and the biosciences in Figure 9 are nearly parallel throughout and generally in the intermediate range, with the social sciences slightly higher. These curves are both crossed by the other two. The physical sciences start lowest and soon cross to the top position; the humanities, arts, professions curve begins in the top position but crosses to the lowest one. The spread of these four fields increases with time, even on the logarithmic scale used to diminish the effect of extreme values.

Four Factors Interact

Four interacting factors can be identified as defining the similarities and differences in these curves: age, sex, employer category, and major function performed. Age helps to give a generally convex form to all these curves, as rates of salary increase tend to drop off as people near retirement. Age affects the several fields differently, as the physical scientists are the youngest of a given graduation cohort, and the humanities, arts, professions group is the oldest. Therefore, they are really at somewhat different career stages, as described earlier in this chapter with reference to the academic ladder. A higher growth rate is therefore to be expected for the physical scientists, from an originally lower position, with the opposite effect characterizing the humanities, arts, professions group.

FIGURE 9
Geometric Mean of Annual Salaries of Cohort 1 from 1935 to 1963, by Field, All Experience Groups Combined

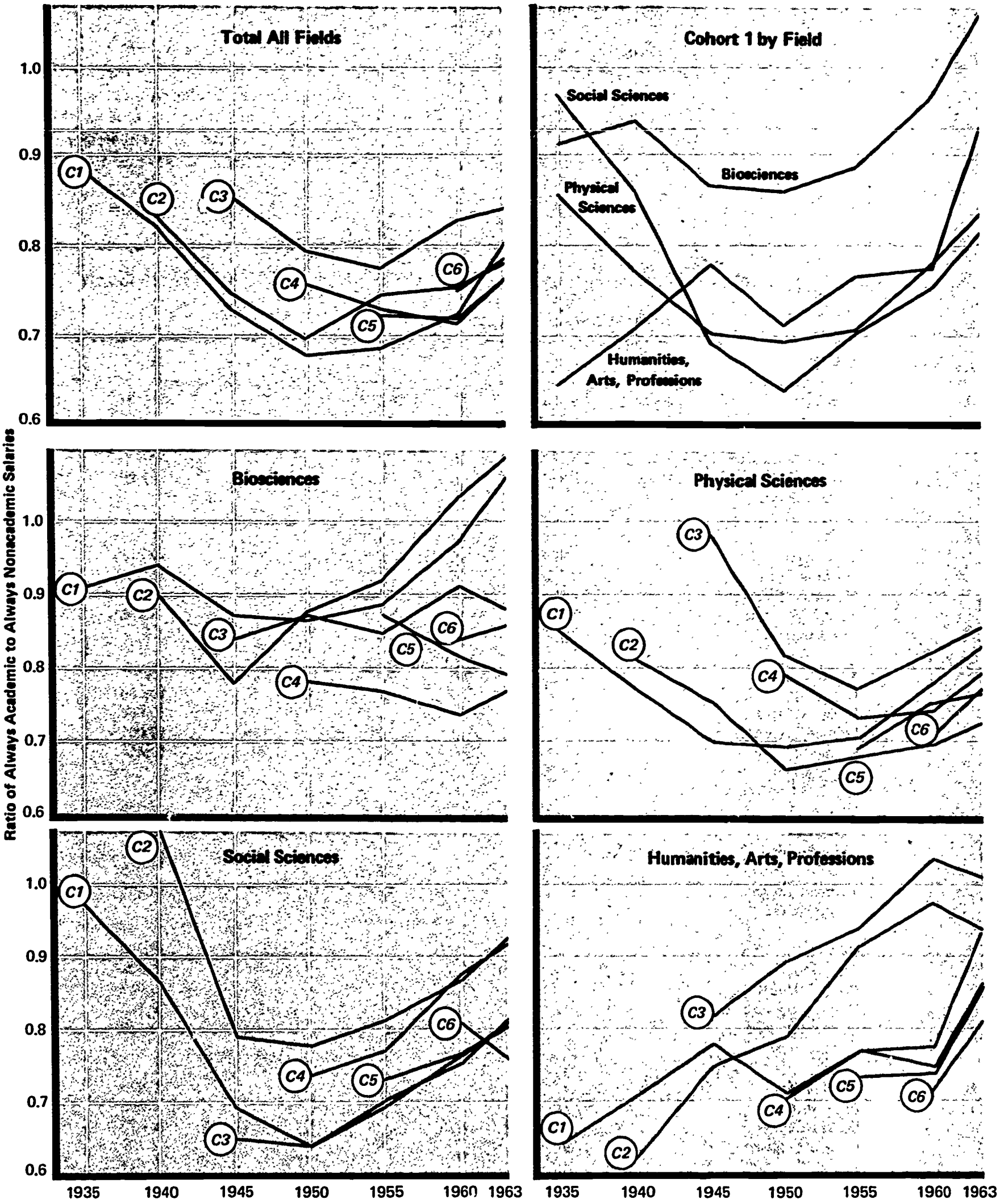


Another factor is employer category: business and industry pay the highest salaries, and the proportion of the group employed by business and industry is highest for the physical sciences group. Academic salaries are the lowest, and the proportion of those academically employed is high in the biosciences and still higher in the humanities, arts, professions group. A third factor is function performed: administration pays the highest salaries. Examination of Appendix 17 of Profiles of Ph.D's in the Sciences shows that 26% of the physical scientists, as compared with 20% of the bioscientists, 16% of the social scientists, and 13% of the humanities, arts, professions field of Cohort 1 were in the high-salaried group that spends 50% or more of its time in administration. The final factor is sex. Women's salaries tend to be lower for comparable jobs, and women are rare in the physical sciences group but form a substantial minority in the other fields. Salaries of women will be examined more closely in Chapter IV, which is devoted entirely to analysis of the data on women's careers.

Some Employers Pay More

Employer category as a variable affecting salary level can be demonstrated in several ways. Tables 6, 7, and 8 and Figure 10 provide direct comparisons between salary levels of those in the AA and NN groups. Tables 6 and 7 give data for these two groups by cohort, field, and time period, and Table 8 gives the ratios of corresponding cells in these tables, or the AA/NN ratios. Figure 10 shows these ratios graphically. In general, the academic salaries average less than 80% of the nonacademic, as is clear from the family of curves for the several cohorts (all fields combined) in the upper left portion of Figure 10. In the upper right portion of Figure 10, the data for the 1935 graduates (Cohort 1) are

FIGURE 10
Ratio of Always-Academic to Always-Nonacademic (AA/NN) Salaries by Cohort, Field, and Time Period



shown by field for the whole period 1935–1963. The lower portion of the figure has a family of curves for each field, showing academic-to-nonacademic ratios for successive cohorts within each field. Typically, the AA group starts with salaries about one tenth lower than those of the NN group, and the disparity increases for over a decade. Then the academic salaries tend to catch up to the nonacademic ones, but in this data series they seldom reach parity. Exceptions occur in Cohorts 1 and 2 in the biosciences and in Cohort 3 in the humanities, arts, professions group. In the social sciences, Cohort 2 academic salaries began higher than the nonacademic, but dropped precipitously to 80% of parity and then recovered about half of the initial loss by 1963. In the physical sciences, academic salaries are always more than 10% below the nonacademic level. There

TABLE 6

Geometric Mean of Annual Salaries of Always-Academic Group from PhD Graduation to 1963, by Field and Cohort

		ANNUAL SALARY BY YEAR						
COHORT	FIELD	1935	1940	1945	1950	1955	1960	1963
1	TOTAL	$2,179	$3,193	$4,482	$6,616	$8,805	$11,431	$14,341
	Biosciences	2,099	3,038	4,279	6,433	8,574	11,696	14,690
	Social Sciences	2,324	3,297	4,677	6,839	9,049	11,770	14,328
	Physical Sciences	1,938	3,006	4,696	7,415	10,322	14,299	17,179
	Humanities, Arts, Professions	2,265	3,326	4,428	6,311	8,261	10,095	13,104
2	TOTAL		2,416	3,839	5,686	8,086	11,075	13,558
	Biosciences		2,360	3,716	6,086	8,487	12,048	14,983
	Social Sciences		2,490	3,938	6,128	8,401	11,803	14,210
	Physical Sciences		2,330	4,103	5,983	8,293	12,070	14,946
	Humanities, Arts, Professions		2,439	3,743	5,184	7,666	9,936	12,131
3	TOTAL	3,765	5,644	7,652	10,782	13,621		
	Biosciences	3,564	5,612	7,657	10,695	13,291		
	Social Sciences	3,477	5,585	7,736	10,664	13,372		
	Physical Sciences	4,061	5,966	8,255	12,081	15,396		
	Humanities, Arts, Professions	3,893	5,567	7,391	10,414	13,243		
4	TOTAL		4,525	6,769	9,762	12,658		
	Biosciences		4,518	6,697	9,226	11,666		
	Social Sciences		4,420	6,943	10,275	13,294		
	Physical Sciences		4,666	7,067	10,920	14,229		
	Humanities, Arts, Professions		4,523	6,556	9,185	12,042		
5	TOTAL			5,316	8,102	10,770		
	Biosciences			5,405	7,939	10,273		
	Social Sciences			5,184	8,017	10,978		
	Physical Sciences			5,430	9,348	12,128		
	Humanities, Arts, Professions			5,308	7,736	10,350		
6	TOTAL				6,976	8,980		
	Biosciences				6,695	8,376		
	Social Sciences				6,833	8,978		
	Physical Sciences				7,200	9,485		
	Humanities, Arts, Professions				7,113	9,078		

is a good deal of resemblance in the curves for the biosciences, social sciences, and physical sciences, in general, but the heterogeneous humanities, arts, professions group has quite a different curve. In this group, there is a general movement of the academic salaries toward parity with the nonacademic ones, for all cohorts, throughout the series. But the starting point is always very low, ranging from 62% to 82%; in the sciences, the typical starting salary is higher, ranging from 69% to 91% in the natural sciences and from 65% to 108% in the social sciences. In the humanities, arts, professions group, the initial salaries have been coming closer to parity in the recent cohorts; the opposite is true in the sciences—the more recent cohorts have shown a greater disparity between the academic and nonacademic salaries than did the earlier ones.

TABLE 7

Geometric Mean of Annual Salaries from PhD Graduation to 1963, by Field and Cohort, for Those Always in Nonacademic Employment

		ANNUAL SALARY IN REPORTING YEAR						
COHORT	FIELD	1935	1940	1945	1950	1955	1960	1963
1	TOTAL	$2,471	$3,914	$6,186	$9,748	$12,773	$15,802	$17,795
	Biosciences	2,304	3,234	4,923	7,426	9,630	12,095	13,858
	Social Sciences	2,395	3,812	6,748	10,699	12,864	15,614	17,596
	Physical Sciences	2,263	3,875	6,697	10,692	14,610	18,201	20,680
	Humanities, Arts, Professions	3,532	4,709	5,665	8,862	10,742	12,951	14,041
2	TOTAL		2,903	5,208	8,130	10,820	14,701	17,498
	Biosciences		2,622	4,742	6,934	9,225	11,652	13,648
	Social Sciences		2,312	4,963	7,836	10,322	13,576	15,330
	Physical Sciences		2,875	5,441	8,982	12,087	17,295	20,536
	Humanities, Arts, Professions		3,941	4,975	6,546	8,396	10,181	12,944
3	TOTAL			4,412	7,104	9,826	13,061	16,218
	Biosciences			4,250	6,418	8,972	11,770	15,053
	Social Sciences			5,358	8,764	11,112	13,877	16,483
	Physical Sciences			4,121	7,295	10,634	14,666	17,918
	Humanities, Arts, Professions			4,759	6,225	7,889	10,060	13,108
4	TOTAL				5,957	9,269	13,634	16,509
	Biosciences				5,764	8,643	12,468	15,240
	Social Sciences				6,002	8,990	11,701	14,544
	Physical Sciences				5,883	9,646	14,659	17,886
	Humanities, Arts, Professions				6,405	8,509	12,228	13,928
5	TOTAL					7,324	11,220	14,077
	Biosciences					6,179	9,723	12,909
	Social Sciences					7,069	10,473	13,639
	Physical Sciences					7,816	12,424	15,726
	Humanities, Arts, Professions					7,227	10,436	12,037
6	TOTAL						9,290	11,453
	Biosciences						8,005	9,770
	Social Sciences						8,447	11,809
	Physical Sciences						10,069	12,261
	Humanities, Arts, Professions						9,907	11,230

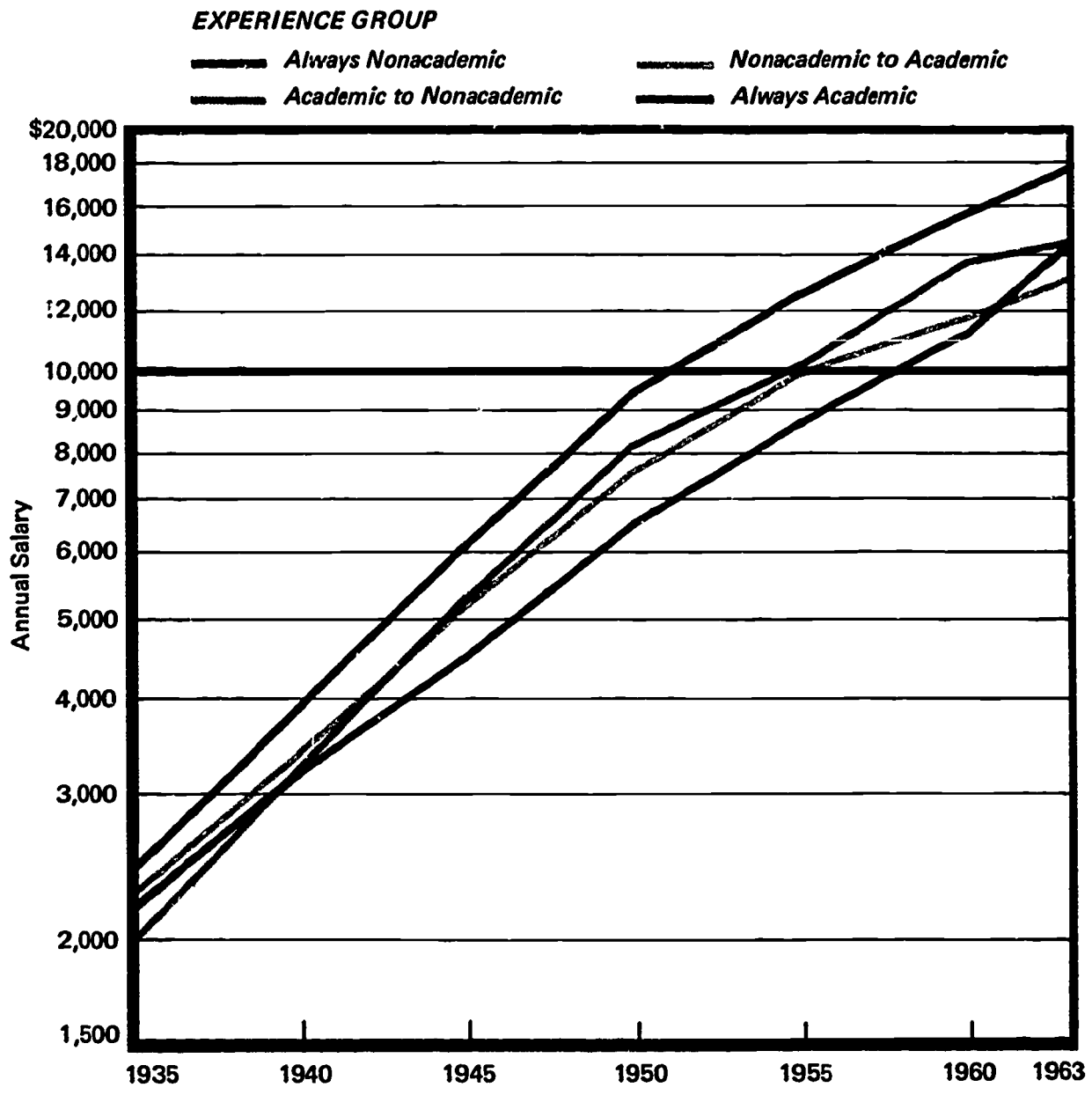
TABLE 8

Ratio of Salaries of the Always-Academic to the Always-Nonacademic Groups (AA/NN), by Field and Cohort, from PhD Graduation to 1963

		AA/NN SALARY RATIO BY REPORTING YEAR						
COHORT	FIELD	1935	1940	1945	1950	1955	1960	1963
1	TOTAL	88.2	81.6	72.5	67.9	68.9	72.3	80.6
	Biosciences	91.1	93.9	86.9	86.6	89.0	96.7	106.0
	Social Sciences	97.0	86.5	69.3	63.9	70.3	75.3	81.4
	Physical Sciences	85.6	77.6	70.1	69.4	70.7	78.6	83.1
	Humanities, Arts, Professions	64.1	70.6	78.2	71.2	76.9	77.9	93.3
2	TOTAL		83.2	73.7	69.9	74.7	75.3	77.5
	Biosciences		90.0	78.4	87.8	92.0	103.4	109.8
	Social Sciences		107.7	79.3	78.2	81.4	86.9	92.7
	Physical Sciences		81.0	75.4	66.6	68.6	69.8	72.8
	Humanities, Arts, Professions		61.9	75.2	79.2	91.3	97.6	93.7
3	TOTAL			85.3	79.4	77.9	82.6	84.0
	Biosciences			83.9	87.4	85.3	90.9	88.3
	Social Sciences			64.9	63.7	69.6	76.8	81.1
	Physical Sciences			98.5	81.8	77.6	82.4	85.9
	Humanities, Arts, Professions			81.8	89.4	93.7	103.5	101.0
4	TOTAL				76.0	73.0	71.6	76.7
	Biosciences				78.4	77.5	74.0	76.5
	Social Sciences				73.7	77.2	87.8	91.4
	Physical Sciences				79.3	73.3	74.5	79.6
	Humanities, Arts, Professions				70.6	77.0	75.1	86.5
5	TOTAL					72.6	72.2	76.5
	Biosciences					87.5	81.7	79.6
	Social Sciences					73.3	76.5	80.5
	Physical Sciences					69.5	75.2	77.1
	Humanities, Arts, Professions					73.4	74.1	86.0
6	TOTAL						75.1	78.4
	Biosciences						83.6	85.7
	Social Sciences						80.9	76.0
	Physical Sciences						71.5	77.4
	Humanities, Arts, Professions						71.8	80.8

Some of these same effects are also evident in Figure 11 in a different fashion. Figure 11 shows salary experience of Cohort 1 (1935 graduates) for all fields combined, but separated by experience group, and includes those who switched employer category, as well as the AA and NN groups. Table 9 is similar, except that, for groups AN and NA, the data entered are only for those people who switched employer category since the preceding reporting period. In Figure 11, the various switch groups are combined, so that the same set of individuals is represented at all points in the curve. All fields are combined in Figure 11 to minimize field differences per se. Those people always in nonacademic employment are highest, and those always in academic employment are usually the lowest. There are two exceptions to the latter statement. Once was in 1935, when those who later switched out of academe were lower in salary

FIGURE 11
Geometric Mean of Annual Salaries of Cohort 1 from 1935 to 1963, by Experience Group, All Fields Combined



than those who stayed. Perhaps the salary differential was a reason for leaving. The other exception was in 1963, where the AA salary figure for this period is out of line with the preceding data and may be unreliable. The salaries of the people who switch from one employer category to another fall between these two extremes and in the expected way: those who switch from academic to nonacademic jobs tend to gain at a higher rate; those who switch from nonacademic to academic jobs gain at a lower rate.

The matter of switching from one employer category to another requires somewhat more precise treatment, as some of the people in each of the experience groups shown in Figure 11 switched early, some in midcareer, others later, yet the data for all switch groups are combined in Figure 11. To study salary as a factor involved at the time of switch requires that we discriminate carefully those who switched at each time period (the switch groups described in Chapter I) and note their salary changes. The data for this detailed study, in terms of the geometric means of salaries, are to be found in Appendix Table C-2. However, the original salary data are awkward to handle when split out into such small groups, and it becomes advisable to use instead the annual salary increment data, as described earlier in the section on Salary Increments Minimize Distortion (see page 24) and given in Table 10. This metric permits combining across cohorts, fields, and time periods, if necessary, to achieve the needed numbers of cases for statistical reliability. Means based on groups of 10 or fewer are shown in parentheses. The numbers of cases in groups AA and NN are sufficient for rather reliable trends to emerge. In groups AN and NA, where the numbers are smaller, the trends within time blocks are less certain.

TABLE 9

Geometric Mean of Annual Salaries by Cohort and Experience Group, All Fields Combined[a]

COHORT	EXPERIENCE GROUP	ANNUAL SALARY BY YEAR 1935	1940	1945	1950	1955	1960	1963
1	**TOTAL**	**$2,210**	**$3,386**	**$5,066**	**$7,607**	**$10,071**	**$12,755**	**$14,906**
	Always Academic	2,179	3,193	4,482	6,616	8,805	11,431	14,341
	Nonacademic to Academic[b]	—	4,265	4,728	6,762	(10,259)	(5,672)	(13,280)
	Always Nonacademic	2,471	3,914	6,186	9,748	12,773	15,802	17,795
	Academic to Nonacademic[b]	—	3,721	5,325	8,128	10,179	(18,664)	(15,452)
2	**TOTAL**		**2,615**	**4,436**	**6,748**	**9,477**	**12,519**	**15,171**
	Always Academic		2,416	3,839	5,686	8,086	11,075	13,558
	Nonacademic to Academic[b]		—	3,606	6,678	10,320	11,087	(12,609)
	Always Nonacademic		2,903	5,208	8,130	10,820	14,701	17,498
	Academic to Nonacademic[b]		—	4,909	8,224	10,188	13,034	(15,978)
3	**TOTAL**			**3,921**	**5,972**	**8,317**	**11,492**	**14,408**
	Always Academic			3,765	5,644	7,652	10,782	13,621
	Nonacademic to Academic[b]			—	5,569	(5,789)	11,421	17,683
	Always Nonacademic			4,412	7,104	9,826	13,061	16,218
	Academic to Nonacademic[b]			—	6,772	9,953	12,371	18,183
4	**TOTAL**				**4,975**	**7,648**	**11,240**	**14,138**
	Always Academic				4,525	6,769	9,762	12,658
	Nonacademic to Academic[b]				—	7,797	10,114	12,123
	Always Nonacademic				5,957	9,269	13,634	16,509
	Academic to Nonacademic[b]				—	9,110	13,935	15,168
5	**TOTAL**					**6,062**	**9,235**	**11,976**
	Always Academic					5,316	8,102	10,770
	Nonacademic to Academic[b]					—	9,207	10,534
	Always Nonacademic					7,324	11,220	14,077
	Academic to Nonacademic[b]					—	9,661	13,536
6	**TOTAL**					**7,614**	**9,723**	
	Always Academic					6,976	8,980	
	Nonacademic to Academic[b]					—	9,256	
	Always Nonacademic					9,290	11,453	
	Academic to Nonacademic[b]					—	10,397	

[a]Salary data based on 15 or fewer cases are enclosed in parentheses.

[b]The data entered on these lines apply *only* to those people who switched employer category since the preceding reporting year.

These annual increment figures can, as mentioned above, be combined for greater stability. This is done in one way in Table 11, which extracts the combined-field data from Table 10, and rearranges it for easier reading. Another way of showing the impact of switch of employer category is illustrated by Figure 12. In this figure, the salary increment data from Table 10 have been collected into frequency distributions. Each percentage increment datum from Table 10 becomes one case in the accumulation. There are thus 84 such items of data in each of the complete experience groups AA and NN in Figure 12. Groups AN and NA are incomplete in Table 10, because of small numbers of cases in some of the switch groups; in Figure 12 the distributions are correspondingly smaller. The distribution of the 84 salary increment figures for the AA group is shown in the top diagram in Figure 12. These increments range from a low of 4% per annum to a high of 20% per year, with a modal point of 8% per year for the entire group. The median gain for this group is 8.4% per

FIGURE 12
Frequency Distribution of Percentage Increments in Annual Salary, by Experience Group

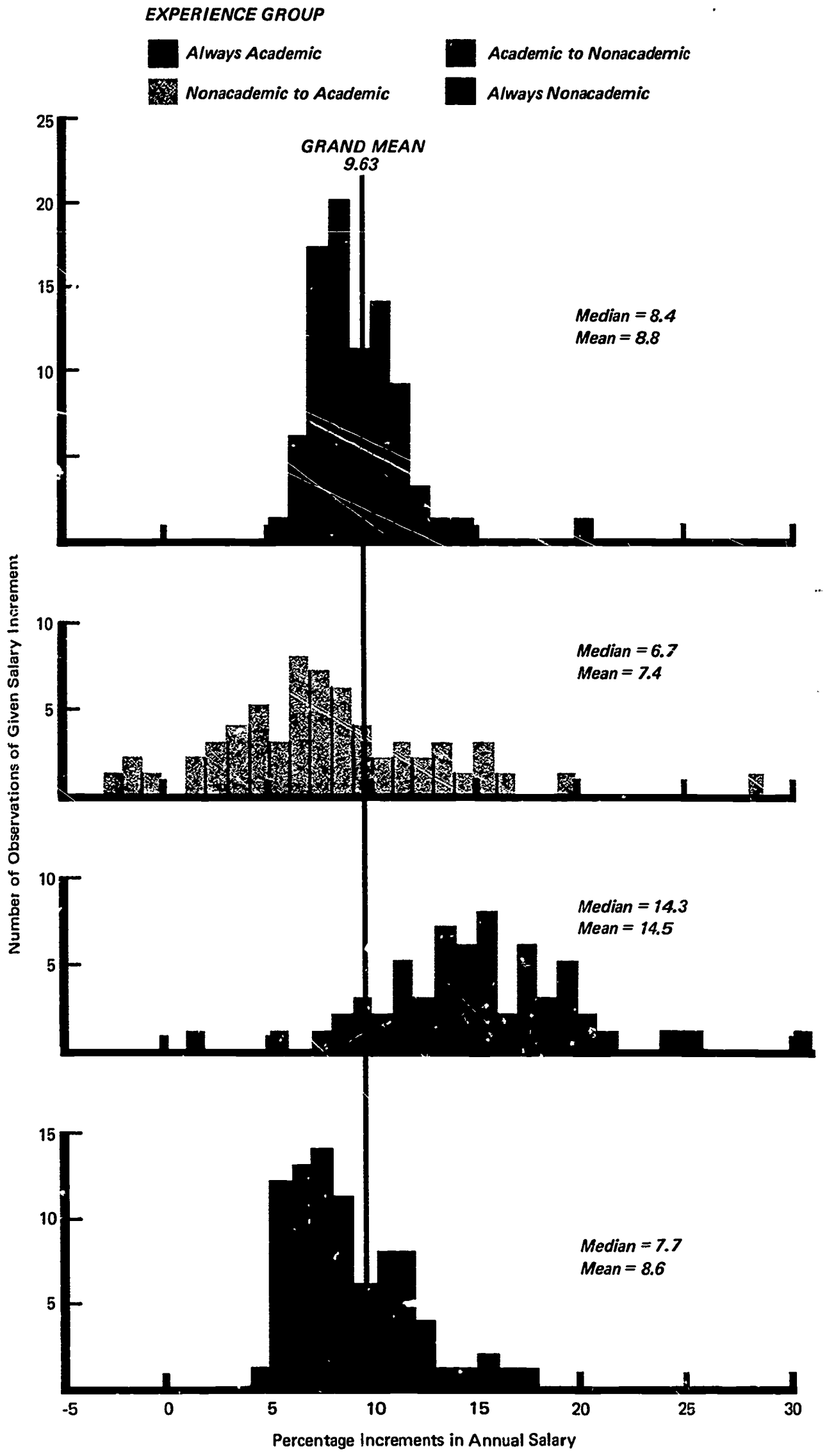


TABLE 10

Percentage Increments in Average Annual Salaries by Field, Experience Group, Cohort, and Time Period[a]

EXPERIENCE GROUP	FIELD	PERCENTAGE INCREMENTS IN SALARIES BY COHORT AND TIME PERIOD									
		1935-1940	1940-1945		1945-1950			1950-1955			
		C 1	C 1	C 2	C 1	C 2	C 3	C 1	C 2	C 3	C 4
Always Academic	**TOTAL**	7.9	7.7	11.3	8.5	9.3	9.4	6.2	8.0	6.7	9.1
	Biosciences	7.7	7.5	11.6	9.0	11.3	10.4	6.1	7.2	7.1	8.5
	Social Sciences	7.2	8.1	11.0	8.5	9.6	11.3	6.3	6.9	7.2	10.3
	Physical Sciences	9.1	10.1	13.4	10.1	8.4	9.1	6.9	7.3	6.9	9.4
	Humanities, Arts, Professions	8.0	6.7	10.5	7.7	8.4	8.2	6.0	9.1	6.3	8.4
Nonacademic to Academic[b]	**TOTAL**	**11.8**	**6.8**	**13.4**	**8.4**	**6.8**	**7.1**	**3.7**	**8.1**	**4.1**	**11.6**
	Biosciences	12.4	–	7.4	(6.1)	8.4	9.5	(3.9)	6.6	(4.0)	(13.8)
	Social Sciences	5.0	(3.3)	(15.2)	12.9	1.8	(4.4)	(5.2)	(6.3)	(6.2)	(12.2)
	Physical Sciences	(8.0)	(9.4)	(5.0)	4.9	11.2	6.5	(3.4)	–	–	6.7
	Humanities, Arts, Professions	–	–	–	(7.0)	6.4	(7.1)	–	–	–	(15.5)
Always Nonacademic	**TOTAL**	**9.6**	**10.9**	**14.6**	**11.8**	**10.0**	**11.1**	**6.2**	**7.5**	**7.2**	**10.0**
	Biosciences	7.0	10.8	14.1	9.5	8.2	10.2	5.7	6.6	7.5	9.3
	Social Sciences	9.7	16.2	30.0	10.0	10.5	12.2	3.5	7.7	5.2	8.9
	Physical Sciences	11.3	12.1	14.5	11.4	11.0	12.1	6.7	8.1	8.0	11.0
	Humanities, Arts, Professions	5.9	4.1	10.2	15.1	6.2	8.9	6.3	5.6	6.6	6.9
Academic to Nonacademic[b]	**TOTAL**	**16.3**	**14.3**	**18.3**	**17.6**	**15.8**	**14.5**	**13.9**	**14.1**	**14.4**	**14.0**
	Biosciences	11.4	12.8	14.8	25.0	30.1	16.3	(17.4)	14.3	15.4	12.4
	Social Sciences	–	17.0	24.3	(7.0)	(10.6)	19.2	(7.7)	10.9	13.2	15.1
	Physical Sciences	18.8	(14.5)	19.2	(13.5)	17.2	13.1	(17.8)	15.8	13.8	13.8
	Humanities, Arts, Professions	–	–	–	–	–	–	–	(14.7)	–	(14.1)

[a]Percentages based on groups of less than 10 are shown in parentheses.

[b]The Academic-to-Nonacademic and Nonacademic-to-Academic groups represent those who shifted *at that particular interval* and are not the same individuals at various increment periods.

year, the mean is 8.8%. In all the groups, the means are higher than the medians, because there is always a positive skew to the distributions. The grand mean, shown by the heavy line running down through the four distributions, is a gain of 9.6% per year for all groups combined. It might be noted that the percentage rates of gain for the AA group are larger than for the NN group. This is compatible with lower absolute gains for the academicians, because the nonacademic group started from a higher base, and the differential was never erased.

Chief interest, however, centers on the groups who switch into and out of academic life. These are illustrated by the second and third distributions in Figure 12. Those who switch from nonacademic to academic employment experience a median annual salary increment of 6.7% per year; those who switch from academic to nonacademic employment do more than twice as well, with a median gain of 14.3% per annum. Only one out of four of the gains of the NA group is above the grand mean; only one out of eight of the gains of the AN group is below it. The salary gain inducement to switch out of academic life, or the inhibition to switching into it, is thus rather dramatically highlighted.

Another interesting feature is the spread of the incremental rates. Those who never switched employer categories are relatively homogeneous in salary growth rates; those who switched are highly variable. These are, of course, the increments experienced at the point of switching employer category. It is apparent that some made large gains by the switch, but that some, particularly in going into academic work, made very minor gains. As will be shown later, these

1955-1960					1960-1963							
C 1	C 2	C 3	C 4	C 5	C 1	C 2	C 3	C 4	C 5	C 6	FIELD	EXPERIENCE GROUP
5.9	6.9	7.7	8.1	10.0	10.8	7.5	8.5	10.1	10.8	10.1	**TOTAL**	
6.6	7.6	7.5	6.9	9.1	10.2	7.9	7.9	10.5	9.9	9.5	Biosciences	Always
5.7	7.2	7.1	8.6	10.9	7.9	7.6	8.3	9.6	11.9	11.0	Social Sciences	Academic
6.7	8.1	8.5	9.9	12.2	6.9	8.3	9.7	9.9	9.9	10.5	Physical Sciences	
5.1	5.8	7.9	7.4	20.3	13.9	7.0	8.4	10.3	11.0	9.6	Humanities, Arts, Professions	
3.7	**2.5**	**4.6**	**6.2**	**9.5**	**12.6**	**6.8**	**7.4**	**3.8**	**8.6**	**11.7**	**TOTAL**	
—	4.0	6.6	7.8	8.6	(-2.3)	9.7	—	8.1	28.5	10.8	Biosciences	Nonacademic
(0.8)	(4.0)	(5.9)	7.9	8.7	(14.5)	(13.1)	(14.7)	6.4	3.2	18.6	Social Sciences	to
—	(-1.5)	—	1.6	13.2	—	(0.5)	6.0	-0.9	(-2.5)	2.2	Physical Sciences	Academic[b]
—	—	—	(9.1)	(3.4)	—	—	—	—	(8.0)	11.3	Humanities, Arts, Professions	
5.8	**8.0**	**6.6**	**8.4**	**9.0**	**6.5**	**6.3**	**7.6**	**7.9**	**9.0**	**9.2**	**TOTAL**	
4.7	4.8	6.2	8.2	10.6	6.4	6.8	9.4	7.1	6.7	8.1	Biosciences	Always
12.5	6.3	4.9	6.5	9.8	4.6	5.8	6.3	11.8	10.6	17.3	Social Sciences	Nonacademic
4.8	9.5	6.7	9.0	10.2	7.5	6.3	7.2	7.9	8.8	7.3	Physical Sciences	
5.3	5.1	7.9	8.0	4.7	4.5	6.4	8.3	5.2	7.2	4.9	Humanities, Arts, Professions	
10.9	**11.2**	**10.9**	**15.3**	**14.1**	**12.7**	**9.5**	**10.8**	**13.0**	**17.6**	**21.6**	**TOTAL**	
—	9.0	(10.4)	11.3	11.7	4.6	(8.8)	(13.9)	13.2	16.8	18.1	Biosciences	Academic
—	—	12.2	13.0	12.6	(0.5)	—	—	(20.1)	16.6	18.5	Social Sciences	to
(8.5)	—	11.0	17.7	20.2	—	—	(15.2)	(14.7)	21.3	17.1	Physical Sciences	Nonacademic[b]
—	—	—	(17.9)	—	—	—	(9.6)	(7.9)	(15.0)	12.5	Humanities, Arts, Professions	

switches in employer category were sometimes accompanied by switches in field and in geographic location; any of these factors might affect salary, with the result that varying combinations of them might help to produce the heterogeneity of gains that are shown here.

Six Percent Minimum

Returning to Table 11, which provides stable data by combining fields, it is noteworthy that in this whole set of salary increments the rate of increase is almost never below 6% per year, except for those people who switched from the high-salaried nonacademic category to academic employment in a particular interval. On the average, Group NA does not lose in salary, but the rates of gain are smaller. Table 11 also shows, in general, the gradual decline in the rate of salary increments from one period to the next for a given cohort. There is noticeable, too, a spurt in salary increments in the period 1960–1963 for the first three cohorts. There are two possible sources for this phenomenon. It is entirely possible that it is due to selective response. That is, people who had recently received promotions might be more inclined to return questionnaires than those who did not. It is a general experience in questionnaire studies that response rates are higher for the more "successful" people in a group, regardless of the definition of success. Another possibility is that the older cohorts, having lagged somewhat behind the younger ones in salary increments, were belatedly getting the benefit of the recent increase in academic salaries. Both of these phenomena could, of course, occur simultaneously.

TABLE 11

Percentage Increments in Average Annual Salary by Experience Group, Cohort, and Time Period, All Fields Combined

		PERCENTAGE INCREMENTS BY TIME PERIOD					
COHORT	EXPERIENCE GROUP	1935–1940	1940–1945	1945–1950	1950–1955	1955–1960	1960–1963
1	Always Academic	7.9	7.7	8.5	6.2	5.9	10.8
	Nonacademic to Academic[a]	11.8	6.8	8.4	3.7	3.7	12.6
	Always Nonacademic	9.6	10.9	11.8	6.2	5.8	6.5
	Academic to Nonacademic[a]	16.3	14.3	17.6	13.9	10.9	12.7
2	Always Academic		11.3	9.3	8.0	6.9	7.5
	Nonacademic to Academic[a]		13.4	6.8	8.1	2.5	6.8
	Always Nonacademic		14.6	10.0	7.5	8.0	6.3
	Academic to Nonacademic[a]		18.3	15.8	14.1	11.2	8.5
3	Always Academic			9.4	6.7	7.7	8.5
	Nonacademic to Academic[a]			7.1	4.1	4.6	7.4
	Always Nonacademic			11.1	7.2	6.6	7.6
	Academic to Nonacademic[a]			14.5	14.4	10.9	10.8
4	Always Academic				9.1	8.1	10.1
	Nonacademic to Academic[a]				11.6	6.2	3.8
	Always Nonacademic				10.0	8.4	7.9
	Academic to Nonacademic[a]				14.0	15.3	13.0
5	Always Academic					10.0	10.8
	Nonacademic to Academic[a]					9.5	8.6
	Always Nonacademic					9.0	9.0
	Academic to Nonacademic[a]					14.1	17.6
6	Always Academic						10.1
	Nonacademic to Academic[a]						11.7
	Always Nonacademic						9.2
	Academic to Nonacademic[a]						21.6

[a]Groups Academic to Nonacademic and Nonacademic to Academic represent those who switched *at that particular interval* and are not the same individuals at various increment periods.

Later Cohorts Gain Faster

A more detailed examination of Table 11 reveals further aspects worthy of consideration. For the first four cohorts, the AA group was uniformly lower in salary growth in the first two postdoctoral periods than the NN group. A change occurred with the 1955 cohort, however. In this cohort, the AA group experienced higher growth rates in the first two postdoctoral periods than did the NN group. The 1960 cohort had a similar experience, for the brief time available for observation. It would appear as if academic salaries, having long lagged behind the nonacademic, were beginning to catch up. Table 11 shows rates of salary increase which are perhaps surprisingly high, considering the fact that these are for the same individuals followed through from one period to the next. The lowest average annual increment for those in academic employment is 5.9% for the oldest cohort in the period 1955 to 1960. For the people who graduated in 1950 and later, the lowest rate of increase, in the period 1955 to 1960, is 8.1% per year. Those of the last two cohorts who have remained in academic employment have experienced steady gains of 10% or more per year; for those in nonacademic employment in these cohorts, the rate of increase has been about 9% per year.

The findings of this report are in line with trends that have continued in more recent years, as revealed by a report of the Scientific Manpower Com-

mission.* This excellent survey, which contains a very useful bibliography, has a summary which is worth quoting in full.

> Technical salaries have continued to climb steadily since 1964.
>
> In general, salaries at educational institutions rose more rapidly than those in Government or industry during the period from 1964 to 1966, but despite the more rapid increase, salaries in educational institutions continued to lag behind those paid by the Federal government and by industry and business. In all fields together, median annual salaries rose from $9,600 to $12,000 in educational institutions; from $11,000 to $12,000 in Federal government employment; and from $12,000 to $13,000 in business and industry.
>
> A consistent rise in salary has occurred in all types of employment, although salaries in the lower levels of age and education show a higher relative rise than do the upper levels. Starting salaries, particularly for engineers, have risen more rapidly than salaries for experienced men.
>
> The most rapid salary increases in all fields of science and engineering occur during the first 15 years of employment, and between age 25 and 35. Within areas of specialty, biologists and mathematicians have received higher percentage salary raises in the past two years than physicists or chemists, but the highest paid areas of study continue to be economics, statistics, physics, and engineering. Women in all fields are paid much less than men with comparable training.
>
> By work activity, management and administration of research and development is the best paid for scientists and teaching the lowest paid, except in agricultural sciences, biological sciences, and meteorology. Within the Government, astronomy and space sciences command the highest average salary ($13,474), followed by general engineering ($13,142), aerospace engineering ($12,733), and psychology ($12,173).
>
> In educational institutions, a scientist must reach full professorship to receive a salary approximately that of his average industrial cohort. However, in many cases additional income from consulting and other activities brings the income of teachers more in line with the average industrial salary.

SUMMARY OF CHAPTER II

Rank and salary appear to have the greatest possibilities for measuring factors related to employer category. Changes in the academic ladder over the 25 years covered by this study were examined by cohorts, fields, and time periods, and several findings of intrinsic interest were made, but rank as a measuring-stick proved unsatisfactory. Only income proved feasible of direct and systematic analysis, of all the factors considered.

Hours worked per week, variations in employment function (research, teaching, administration), and changes in geographic locale were found unusable as affording a quantitative correlate of change in employer category, but were worth reporting in their own right, and are described in Chapter III.

Income was found, despite certain limitations, to be a significant correlate of change: there are distinct differences in salary levels and in rates of salary increase, by employer categories. Furthermore, these differences are in the expected direction, and changes in salary-increase rates occur at the expected points in time. Shifting from academic to nonacademic jobs generally results in a jump in the rate of salary growth; shifting from nonacademic jobs to academe generally results in a drop in the rate of salary growth. The inference is plain that salary differentials are an important factor involved in these changes. At the same time, it must be recognized that salary figures alone cannot tell the whole story. Other factors, including fringe benefits and freedom of work activity, which were not included in this survey, are of unquestioned importance. Research support, or lack of it, hours, and work functions are also involved. The following chapter will describe some of these other findings, although it was not possible to relate them directly or significantly to employment shift.

*Salaries of Scientists, Engineers and Technicians . . . A Summary of Salary Surveys, prepared by the Scientific Manpower Commission, Washington, D.C., June 1967.

CHAPTER III CORRELATES OF EMPLOYMENT CHANGE

SUPPORT FOR GRADUATE EDUCATION

Governmental and private support for graduate education, by field of PhD and by cohort, are described in detail in the earlier report, Profiles of Ph.D's in the Sciences. The question to be examined here is whether there is any relationship between the sources of support for graduate education and later career patterns. In particular, one might ask whether there is any relationship between governmental support and later careers. In the present study, the four career experience groups, by field, were examined to determine the relative degree of support they had had from various sources. Because the sources of support were many, and because only a small minority of people relied on a single source of support, it was necessary to combine the sources into meaningful categories and then examine the extent to which each category provided support for the members of each experience group.

The amount of support for graduate education for each cohort is shown graphically in Figure 13. This closely resembles Figure 8 of the earlier report, but it is based on all fields, rather than on the biosciences alone. The lower half of Figure 13 simplifies the data by accumulating the first three cohorts (1935, 1940, and 1945) into a single "prewar cohort," and the last three cohorts (1950, 1955, and 1960) into a single "postwar cohort." It also combines the support sources into three general categories: (A) all federal government agencies with their various types of support; (B) all institutional sources, including university, foundation, and other fellowships, assistantships, and traineeships; and (C) all the individual's private resources, including earnings of self and spouse, contributions of parents, savings, and borrowings. This third category has been termed "own resources."

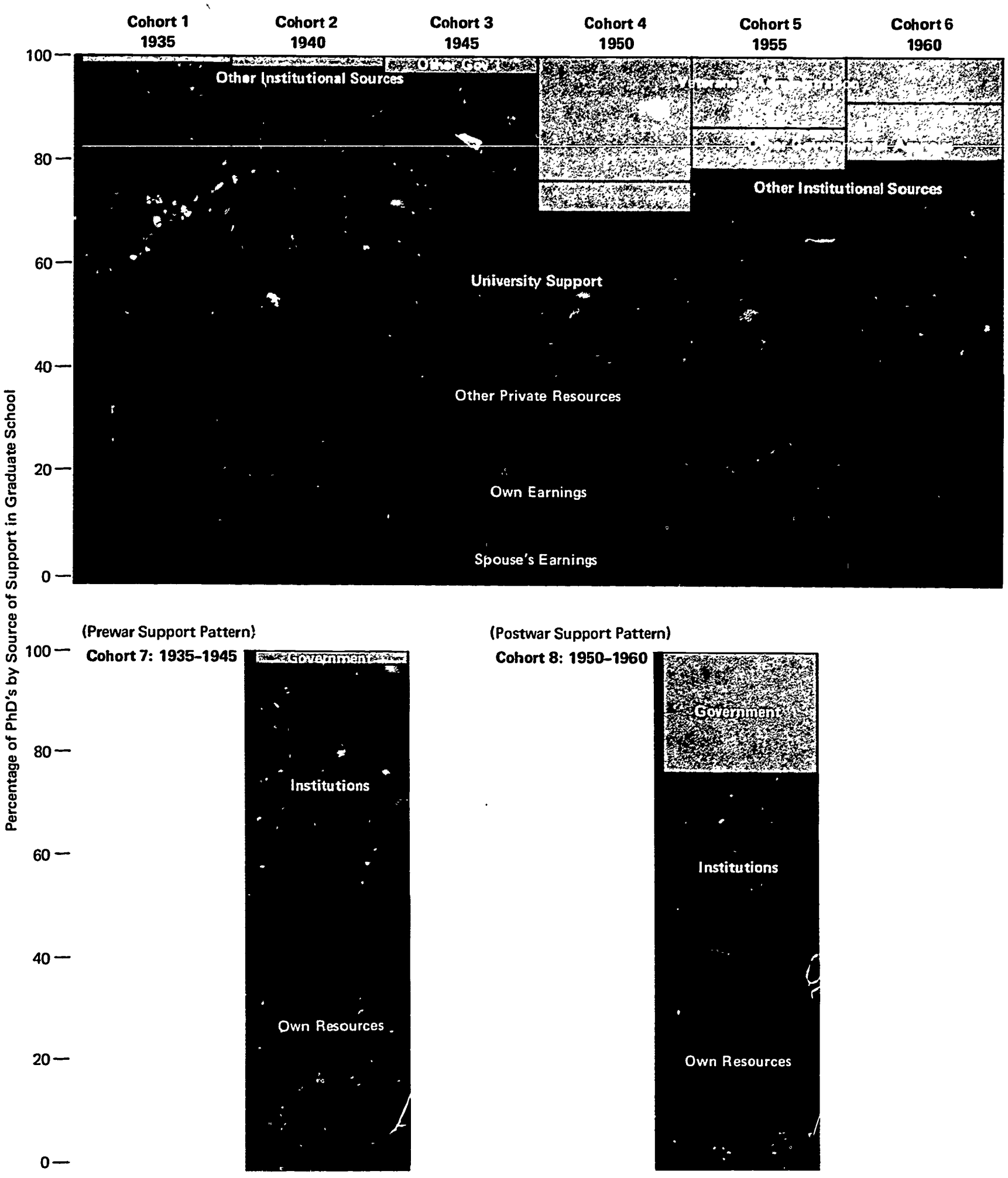
Shifting Base of Support

Several comments might be made about the data of Figure 13. The most dramatic is the increase in governmental support from the prewar to the postwar period. Another is the decrease in "own resources" and, within this category, the increase in the importance of spouse's earnings. The third is the decrease in institutional support, particularly that from universities. Within the governmental category, the bulk of the support was provided by the Veterans Administration and thus was not mission-related. The VA support, however, was tapering off throughout the last three cohorts, so that other programs, more directly related to various academic and scientific objectives, were becoming more important. However, the analyses done here were for all governmental sources combined, as breakouts within them were not feasible because of the small numbers of cases involved.

Governmental sources of support prior to World War II were too meager to justify analysis, and furthermore the conditions of graduate education have changed so much since that time that conclusions based on that period would probably not be applicable today. Attention is therefore focused exclusively on the postwar cohort throughout the rest of this analysis. The three-way breakout of support shown for this cohort in the lower right portion of Figure 13 is

FIGURE 13

Major Sources of Graduate School Support by Cohort, All Fields and Experience Groups Combined



Source: Unweighted Data from *Profiles of PhD's in the Sciences,* pp. 92-94

maintained in Figure 14, where further breakouts of this cohort are provided by field and by experience group, the numerical data for which are provided by Table 12. The data for those who remained in either the academic or nonacademic categories throughout the period were the only ones sufficiently massive to justify breakout by field. The results are quite striking, both as to the differences between the academic and nonacademic experience groups, and between fields. The most significant effects relate to institutional support; the others seem to follow as a necessary consequence. Because of the field differences, it seems important first to describe the differences and then to make further analyses to try to isolate possible reasons for the differences.

Field Variations

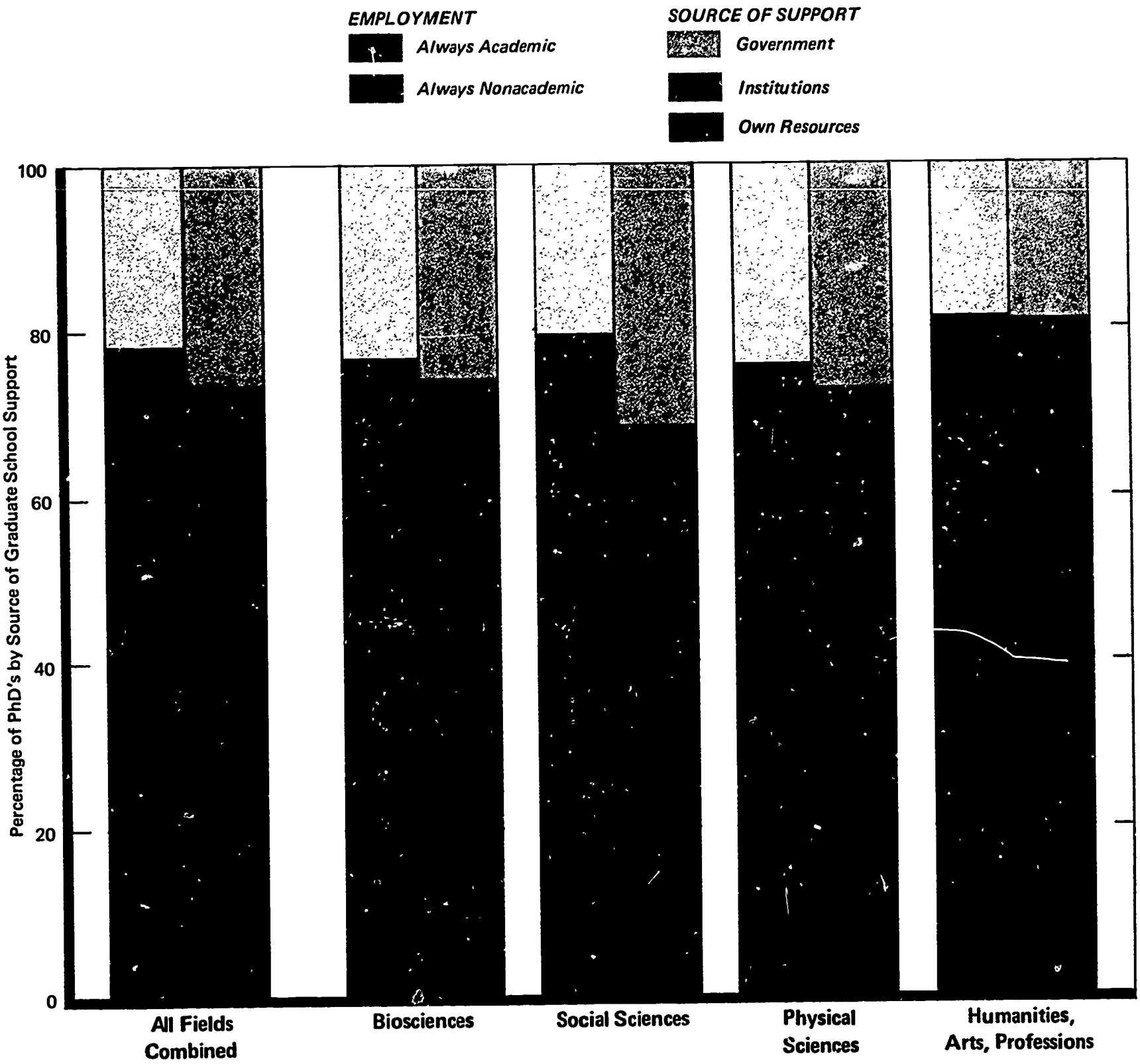
The first two bars in Figure 14 depict the sources of support for those in all fields combined who were later either always academic or always nonacademic in employment. There is a slight difference in amount of governmental support between the academic and nonacademic groups, but a considerably larger difference in the amount of institutional support. It appears as if those who derive their support from institutional sources are more likely to stay in the academic environment. The difference in this direction persists throughout all four fields, but it is much larger in some than in others. In the biosciences, the difference between percentages is 9.7%; in the social sciences it is 13.3%; but in the physical sciences it is only 4.5%, a difference that, although statistically significant, is of little practical importance. It is in the field of humanities, arts, and professions, however, that this difference becomes really dramatic (17.7%), the always-academic group receiving 27.7% of its support from institutional sources, and the nonacademic group receiving only 9.9% of its support from these sources. In this same field there is almost no difference in governmental support between the academic and nonacademic groups; the difference in "own resources" is substantial—17.1%. This gives a clue that is useful in understanding these variations in support. The humanities, arts, professions field is the most heterogeneous of the four; a large portion of it is the educators, where a very different pattern

TABLE 12

Percentage of Graduate School Support from Three General Sources, by Field, for the Always-Academic and Always-Nonacademic Groups, Postwar Cohort 8

FIELD	SOURCE OF SUPPORT	ALWAYS ACADEMIC (%)	ALWAYS NONACADEMIC (%)	DIFFERENCE AA - NN (%)
TOTAL	Government	21.7	26.4	- 4.7
	Institution	38.5	31.8	+ 6.7
	Own Resources	39.8	41.8	- 2.0
Biosciences	Government	23.3	25.8	- 2.5
	Institution	45.2	35.4	+ 9.8
	Own Resources	31.5	38.8	- 7.3
Social Sciences	Government	20.6	31.5	-10.9
	Institution	32.9	19.6	+13.3
	Own Resources	46.4	48.8	- 2.4
Physical Sciences	Government	24.2	27.2	- 3.0
	Institution	43.3	38.8	+ 4.5
	Own Resources	32.5	34.0	- 1.5
Humanities, Arts, Professions	Government	18.2	18.8	- 0.6
	Institution	27.7	9.9	+17.7
	Own Resources	54.2	71.3	-17.1

FIGURE 14
Relationship of Sources of Graduate School Support to Later Academic and Nonacademic Employment by Field, Postwar Cohorts Combined



of graduate education is characteristic. The education majors typically work intermittently with periods of graduate education or complete a large portion of their graduate studies in summer school, while holding down regular jobs during the academic year. They are typically much older than students in other fields, averaging close to 40 at the time of receipt of the doctorate. Their postdoctoral employment is also very different from the other fields, as substantial numbers of them are employed by state or local governments and concerned with elementary or secondary education. By the definition we have adopted here, this is "nonacademic," meaning not in a college or university. A similar, although less distinct, pattern of education and employment characterizes the other professions, in contrast to the arts and humanities field which is overwhelmingly academically employed. More of the arts and humanities group than of the education group are supported by assistantships and fellowships during the graduate years.* Most of the pattern of differences in Figure 14 can be accounted for in these terms, although other factors may also be at work. For example, in the social sciences, in which the next-largest difference appears, there is a difference between the two subfields, the behavioral and social sciences; these two groups vary as to both sources of support and subsequent employment. Examination of the data of Profiles of Ph.D's in the Sciences shows that psychologists get less university support and more support from government than do the social scientists, and that they are proportionately more likely to be employed by the U.S. or state governments and nonprofit organizations and less likely to be employed by universities than are the social scientists. It may be that this reflects governmental support of clinical psychology by both the VA and the Public Health Service immediately after World War II, and the fact that these clinicians work primarily in hospitals and mental health clinics and to some extent in private practice—all in the nonacademic category.

Multiple Sources

The above line of reasoning seems adequate to account for a considerable portion of the apparent difference between the academic and nonacademic groups in sources of graduate-school support. Concomitant differences in support and employment, operating across rather than within the doctoral subfields, seem to be important in producing the pattern of differences shown. Because the mean differences shown in Figure 14 leave some questions unresolved, it appeared desirable to perform a somewhat more precise analysis of the relation between amount of support and later employment, to see whether the trends of these average amounts would hold. It happens that we are dealing with data in which a very large proportion of any experience group derives no support at all from one particular source and usually varying minor amounts of support from other sources. Only a few derive all their support from a single source. Combining sources, as has been done here, reduces the number of cases in the "no support" category but does not eliminate it. This is illustrated by the table below, which shows, for all fields combined, in the postwar cohort, the amount of support from each source category, in terms of the original scale used to collect the data—by tenths of the individual's entire support requirements.

The table below shows the same total group on each line. The first line shows the percentages of this group that received varying amounts of support from governmental sources. The second line shows the same distribution for institutional sources; the third line shows the percentage distribution by varying amounts of support from "own resources." In 4.3% of the cases, the data were missing entirely or partially, and the support fractions could not be distributed.

*Scientific Manpower Report No. 5, Background and Experience Patterns of the Doctorates of 1962, Office of Scientific Personnel, National Research Council, 1965.

Source of Support	Proportion of Total Support, in Tenths											
	zero	1/10	2/10	3/10	4/10	5/10	6/10	7/10	8/10	9/10	All	Unknown
Government (%)	43.8	4.9	7.0	9.6	8.2	9.2	3.7	3.3	2.3	0.9	2.8	4.3
Institutions (%)	23.7	7.0	8.6	11.1	9.6	11.3	5.0	5.3	4.0	2.9	7.2	4.3
Own Resources (%)	19.9	6.9	10.1	9.6	8.4	11.0	6.9	6.6	4.6	3.6	8.1	4.3

Almost half of the group received no governmental support, almost 1/4 received no institutional support, and 1/5 received their entire support from either institutional or governmental sources, supplying none of their own. Total support from one category or another is found in only 18% of the cases; the other 82% received support from a variety of sources. It appeared desirable to group the varying fractions of total support in order to simplify consideration of these data and also to obtain sufficiently large numbers in a given cell of the table to permit reliable analysis. The groupings finally decided upon were as follows: (A) none, the fairly large group that received no support from a given source category; (B) some, those fractions from 1/10 through 6/10; and (C) major support, those fractions from 7/10 through total support.

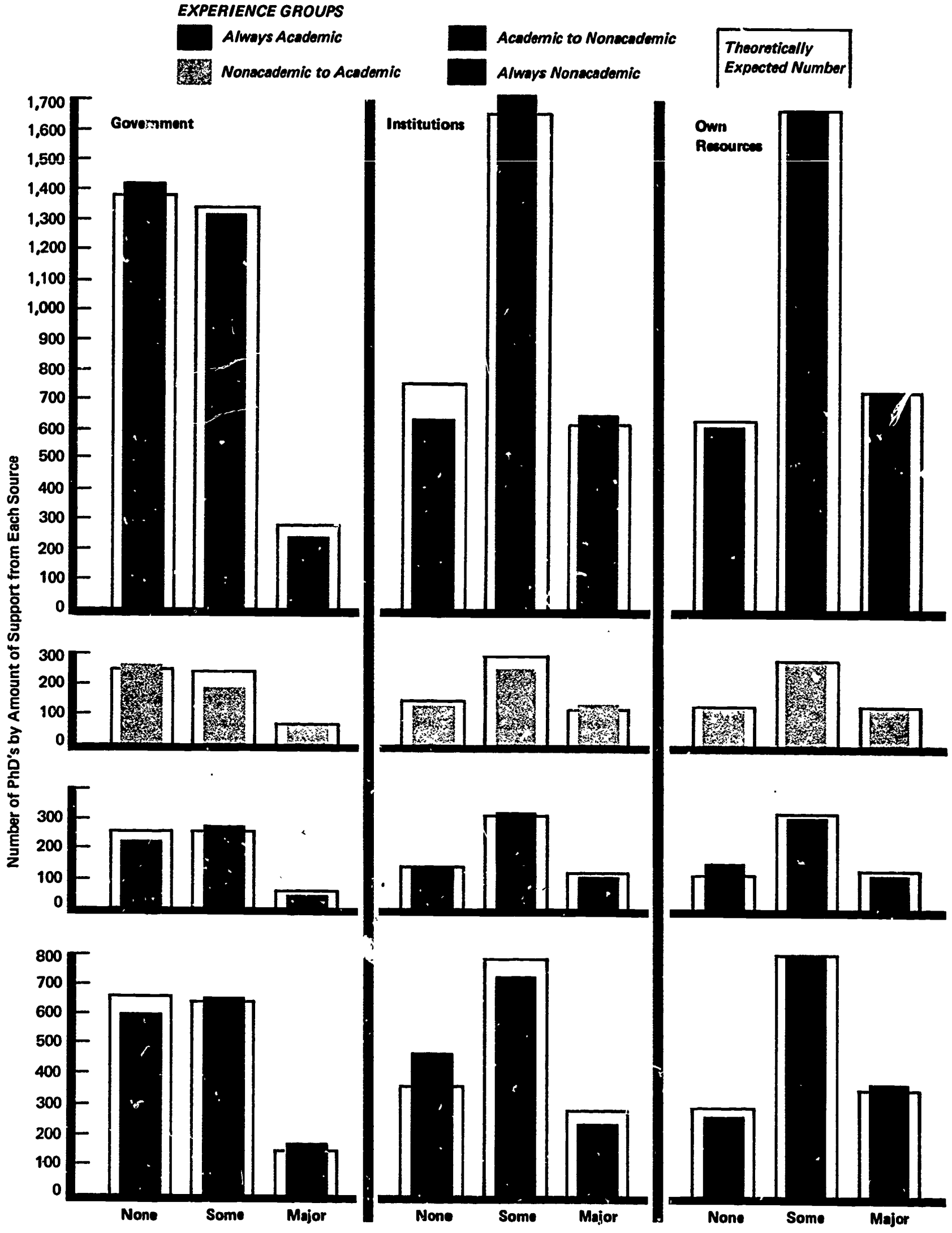
Figure 15 shows graphically the results of dividing the career patterns group into the experience groups, and by amount of support—none, some, or major—from each of the source categories. Each element in this figure compares the actual number of cases observed with the number that would have been found in a given category if there were absolutely no relationship between source of graduate school support and later career. The latter figures—the theoretical values assuming no relationship—were computed by allotting to each experience group the proportion of cases for all experience groups combined that had some, none, or major support from each source category. Theoretical frequencies so derived assume an independence of support and subsequent experience and permit a test of the validity of this assumption by comparing theoretical and actual experience figures. The boxes represent these theoretical frequencies; the shaded bars represent the actually observed numbers in each category. The sets of bars reading from top to bottom represent the always-academic (AA) group, those who switched from nonacademic to academic jobs (NA), those who switched from academic jobs to nonacademic employment (AN), and those who were always in nonacademic positions (NN). The amount of support by government is shown in the left-hand column of three bars (one each for none, some, and major); the amount of support by institutional sources by the middle set of bars; and the amount of support by own and family sources by the set of three bars on the right side of the figure.

The first observation that one might make regarding Figure 15 is that there is in general a very close relationship between theory and observation. This is particularly true with respect to the "own resources" column. Here there are no observable differences in the AA and NA groups; in the AN group slightly fewer than expected had major support from their own sources and slightly more than expected provided none of their own support. In the NN group, the relative balance was reversed. Altogether, the discrepancies in this column are of rather dubious significance, although if the values here were considered independently of the others, the over-all degree of discrepancy would occur only once or twice in a hundred times on the basis of chance variations. With large numbers of cases, such as we have here (5514 cases in all), even small percentage frequency discordances can be statistically significant, even though of no practical importance.

Turning to the middle column in Figure 15, we find more frequent and larger discrepancies between expected and observed values. Of those with some or major institutional and foundation support, more than expected are in the AA group, and fewer than expected are in the NN group. Just the opposite is true

FIGURE 15

Number of PhD's in Cohort 8 by Sources and Amounts of Support in Graduate School, by Experience Group



of those with no institutional support: more are in the NN group than would be found if support were quite unrelated to later careers. The switch groups show only insignificant variations from the theoretically expected values: whether one begins in academe or elsewhere and later switches is practically unrelated to degree of institutional support.

The government-support column shows a pattern exactly the reverse of that for institutional support; of those with major governmental support, fewer than expected are in the AA group and more than expected in the NN group. For those with no governmental support in graduate school, more than expected are in the AA group, and fewer than expected are in the NN group. The AA and NN groups show just about the expected numbers of those with some (0.1 to 0.6) governmental support. The switch groups show minor but statistically significant variations: those with no governmental support are more likely to be in the NA group and less likely to be in the AN group than would be expected on the assumption of independence of support and career patterns. Those with some governmental support are the opposite: more are in the AN and fewer in the NA group than expected.

Discrepancies: Intrinsic or Spurious?

The paragraphs above, and Figure 15, describe the generalized findings for all fields combined. The discrepancies noted between observed frequencies and expected frequencies are statistically significant. Still, they are not very large, and the general impression remains that source of support for graduate education has only a minor relationship to later career pattern. The possibility exists, too, that such discrepancies as are observed may be due to adventitious other variables; the observed relationships are not only minor but may be spurious. As one way to examine this possibility further, the individual fields were analyzed separately, and the Chi Square (χ^2) test was applied to determine whether the discrepancies found were statistically significant. The major results are summarized in Table 13, which gives the data for all fields and groups and the numbers of cases in the AA and NN groups, by field, for each kind and amount of support. The switch groups are omitted except in the biosciences field, as the number of cases was usually too small for statistical significance when the fields were separately considered.

The data of Table 13 may be compared with Figure 15 to observe the effect of field differences in sources of support. The biosciences field is a good place to begin, because it is largest and comes first in the table. There is a general resemblance between the data of Figure 15 (for all fields) and the numbers in Table 13 for the biosciences in the fact that in both cases the observed and calculated values are not greatly different. This is true for the other fields also. Turning to the data on governmental support in the biosciences, one finds no observable effect on the AA group, although there is an apparent relationship in the total of all fields combined. Among bioscientists with no government support, more than expected are in the NA group—those who began in nonacademic work but later switched. Rather paradoxically, the same is true of those with major support from government, while those with intermediate degrees of support occur less frequently in the NA group than theory would predict. The pattern in the AN group (starting in academe and later leaving for other jobs) is reversed. The significance of these switches is not immediately apparent, but the amount of discrepancy is large enough to indicate that it is probably not a mere chance fluctuation, as a set of discrepancies of the magnitude shown in these switch groups is likely to occur less than once in twenty times on a random sampling basis. Finally, there is no relationship between governmental support in the biosciences and later careers exclusively in nonacademic work. In this respect the biosciences are different from the all-fields total.

With respect to institutional support, the biosciences follow the all-fields trend quite regularly. Those with more institutional support are more likely to remain in academe. With respect to "own" support, there are significant career

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TABLE 13

Actual Numbers of PhD's with Various Sources of Support for Graduate Education, by Field and Experience Group, Cohort 8[a]

FIELD	EXPERIENCE GROUP	TOTAL PHD'S[b]	NUMBER OF PHD'S BY SOURCE AND AMOUNT OF SUPPORT IN GRADUATE SCHOOL									
			GOVERNMENT			INSTITUTIONS			OWN			SUPPORT UNKNOWN
			NONE	SOME	MAJOR	NONE	SOME	MAJOR	NONE	SOME	MAJOR	
TOTAL[c]		**5,757**	**2,528**	**2,457**	**529**	**1,368**	**3,033**	**1,113**	**1,145**	**3,051**	**1,318**	**243**
Biosciences	Always Academic	1,305	576	582	116	212 (-46)	708	354 (+31)	360 (+25)	715	199 (-24)	31
	Nonacademic to Academic	204	105 (+17)	67 (-22)	23 (+5)	35	100	60 (+11)	52	110	33	9
	Always Nonacademic	616	256	283	59	176 (+54)	308 (-17)	114 (-37)	130 (-27)	341	127 (+23)	18
	Academic to Nonacademic	269	109	133 (+14)	19 (-5)	49	150	62	70	143	48	8
Social Sciences	Always Academic	739	347 (+27)	330	46 (-22)	167 (-38)	451 (+27)	105 (+11)	88 (-11)	421	214	16
	Always Nonacademic	218	75 (-20)	100	39 (+19)	99 (+38)	101 (-24)	14 (-14)	29	108 (-12)	77 (+13)	4
Physical Sciences	Always Academic	446	181	182	42	68 (-14)	228	109 (+13)	117 (+12)	224	64	41
	Always Nonacademic	542	192	238	55	100	283	102 (-13)	108 (-18)	302 (+20)	75	57
Humanities, Arts, Professions	Always Academic	629	333	231	38	194 (-36)	332 (+28)	76 (+8)	56	308 (+20)	238 (-26)	27
	Always Nonacademic	142	76	48	14 (+4)	93 (+40)	40 (-30)	5 (-10)	5 (-7)	43 (-23)	90 (+30)	4

[a] Where a discrepancy between the observed and calculated values for a given cell was deemed to be statistically significant (yielding a cell contribution to χ^2 of 1.00 or more), the amount of discrepancy is shown in parentheses. Minus signs indicate observed values less than expected, and plus signs indicate observed values greater than expected.

[b] The three support categories (none, some, and major) within each source, plus unknown support, equals the total number of PhD's.

[c] The Nonacademic-to-Academic and Academic-to-Nonacademic groups in the social and physical sciences and the humanities, arts, and professions are included in these totals although not displayed by field.

trends in the biosciences that do not show up in the total of all fields. Significantly fewer of the self-supported are found in exclusively academic careers; those with no self-support are distinctly more likely to enter and remain in academe. Exactly the reverse is true for the never-academic career group: they occur more frequently than expected among those who were chiefly responsible for their own expenses. The switch groups show no pattern here.

Social Sciences Conform to the Norm

In the social sciences, lack of any governmental support is positively related to always-academic careers and negatively related to always-nonacademic careers. Major governmental support is clearly related to the always-nonacademic group. The opposite pattern, and with greater strength, is shown for those with varying degrees of institutional support. Varying degrees of "own" support show

only weak and uncertain relationships with later careers. In all these respects, the social sciences resemble the total of all fields combined. It might be noted here that, because of the necessary interrelationships of degrees of support from various sources, completely independent tests of each source are not possible. [Technically, the full table, with both switch groups included, affords only twelve degrees of freedom, as we have in reality a three-dimensional table: three sources, three amounts from each source, and four career patterns. Subtracting from each of these dimensions one category as necessarily determined by the others, this leaves 2 x 2 x 3 = 12 degrees of freedom. Any one source may be considered alone as offering six degrees of freedom (2 amounts x 3 career patterns), but once support from any two sources is determined, the third is fixed and cannot vary, as the proportions are required to total to 100%.]

In the physical sciences, very little in the way of relationships between sources of support and later careers can be observed. What there is follows the all-fields total, but the relationships are weak, and the χ^2 test is significant only for institutional support. In the humanities, arts, professions field, the pattern for the all-fields total shows up, but in a somewhat different way than in the social sciences and the biosciences. Possible reasons for these field differences may be worth some examination.

Does Field Heterogeneity Induce Patterns?

The fields vary in their homogeneity, and this may be an important factor in the results found. The most homogeneous of the four fields, the physical sciences, shows little in the way of support–career relationships. The most heterogeneous, the humanities, arts, professions group, shows the highest χ^2 total, and the summary table for all fields combined (necessarily the most heterogeneous) shows a still higher χ^2 value. The following table presents this evidence:

Field	χ^2
Biological Sciences	72.5
Social Sciences	86.7
Physical Sciences	26.4
Humanities, Arts, Professions	101.2
Combination of All Fields	130.7

The way in which field heterogeneity can produce a relationship between support patterns and later career patterns is not hard to see, using the humanities, arts, professions group as a model. The professions group includes education, which has patterns of graduate education and of later employment that are quite distinct from those for the arts and humanities. Typically, an EdD or PhD in education is awarded to a man or woman close to 40 years of age, after a long period of intermittent graduate education and employment in school teaching or administration. This group, then, is largely supported in graduate school by "own" sources, including their own salaries and those of spouses. The percentage of education doctorate-holders in college or university employment is much lower than is true of the arts and humanities group. A similar, though less distinct, pattern of education and employment characterizes the other professions, in contrast to the arts and humanities group, which is overwhelmingly academically employed. More of the arts and humanities group than of the education group are supported by assistantships and fellowships during the graduate years.* Most of the pattern of deviations from theoretical expectation in the χ^2 table can be accounted for in these terms, although other factors may also be at work. Those without institutional support provide the largest de-

*Scientific Manpower Report No. 5, Background and Experience Patterns of the Doctorates of 1962, Office of Scientific Personnel, National Research Council, 1965.

viation from theoretical expectation. They are much less likely to be found in academic jobs and much more likely to be found in nonacademic jobs than are those with some or major institutional support or those with no governmental or self-support. Those wholly supported by institutional or governmental sources (zero self-support) are more likely to be in academic jobs and less likely to be in nonacademic jobs than are those who, in part or in whole, support themselves.

Clinicians Are Different

The support versus career relationships in the social sciences also may be due to a matter of field heterogeneity. This field group is composed of both the behavioral and social sciences, and these two groups vary as to both sources of support and subsequent employment. Examination of the data of Profiles of Ph.D's in the Sciences shows that psychologists get less university support and more support from government other than VA than do the social scientists, and that they are proportionately more likely to be employed by the U.S. or state governments and nonprofit organizations and less likely to be employed by universities than are the social scientists. It may be that this reflects governmental support of clinical psychology; these people work primarily in hospitals and mental health clinics, and hence are employed more frequently by governmental units and nonprofit organizations. Some go into private practice, which is also in the nonacademic sector.

Summary: Minor Relationships Only

To summarize the evidence relating graduate-school support to subsequent careers, it can be said that no clear-cut cause and effect relationships are found in these data. In general, the observed frequencies of career patterns, for the various patterns of research support, follow rather closely the frequencies that would be expected if no relationship existed. Minor deviations are found, but some of these relationships can be explained on the basis of incidentally related factors, such as differing practices or customs within various segments of heterogeneous fields. When the fields are separately considered, the most homogeneous one, the physical sciences, shows no statistically significant trends. The biological sciences show some evidence relating university or other private stipends to later academic jobs, as is true for all fields combined. No clearly significant relationship to government subsidy i ound in the biosciences field. In the social sciences field, there is suggestive evidence of the impact of governmental support of clinical psychology, but this does not indicate that it is the support, as such, that affects later employment patterns. In the very heterogeneous humanities, arts, professions field, as in the social sciences and in the all-fields total, those with the greatest institutional support tend to be found later in academic positions. A minor but probably statistically significant trend in the humanities, arts, professions field links governmental support to later nonacademic employment, but the reasons for this relationship seem to be more incidental than causative. Two conclusions follow: (1) These data on the effects of graduate-school support, combined with the findings regarding other predoctoral factors described in Chapter I and elaborated in Appendix B, indicate that, for the people whose careers are examined in this report, further analyses can validly proceed without danger of being distorted by the effects of predoctoral environmental factors; and (2) the effect of massive mission-oriented governmental programs was just beginning to be felt by the time these people had completed their doctoral degrees, and it would be premature to draw any conclusions regarding the impact of these programs from the data at hand.

FUNCTIONAL TIME DISTRIBUTION BY EMPLOYER CATEGORY

A Feedback Model: Employer ↔ Functions

The way one spends his time—the number of hours on the job and the work he does while on the job—is an important consideration in job satisfaction and career satisfaction. It might be expected, therefore, that one of the reasons for shifting from one employer category to another would be to obtain the kind of distribution of one's time that would yield the most satisfaction. Thus it seemed important to examine in some detail the data on time spent in teaching, research, administration, and other functions by those who were employed in academic settings versus those elsewhere employed. The time distribution of those who change employer categories can also be examined in terms of before-switch and after-switch periods, to deduce whatever clues it may furnish with regard to significant career patterns. What is involved here is a variation of the chicken-and-egg problem: which is cause and which is effect? A difference in function related to employer category is inevitable; the academically employed will, of course, devote more time to teaching than will those employed elsewhere. But the relationships observed are not limited to this simple difference; they vary also as a function of career maturation and by time period. The amount of time devoted to research has increased gradually from 1935 to the present, for people at equivalent career stages, while administrative work increases as a function of age. The influence of career stage was described in some detail in the earlier report, Profiles of Ph.D's in the Sciences, but was not broken out by employer categories. What is needed now is a more searching analysis.

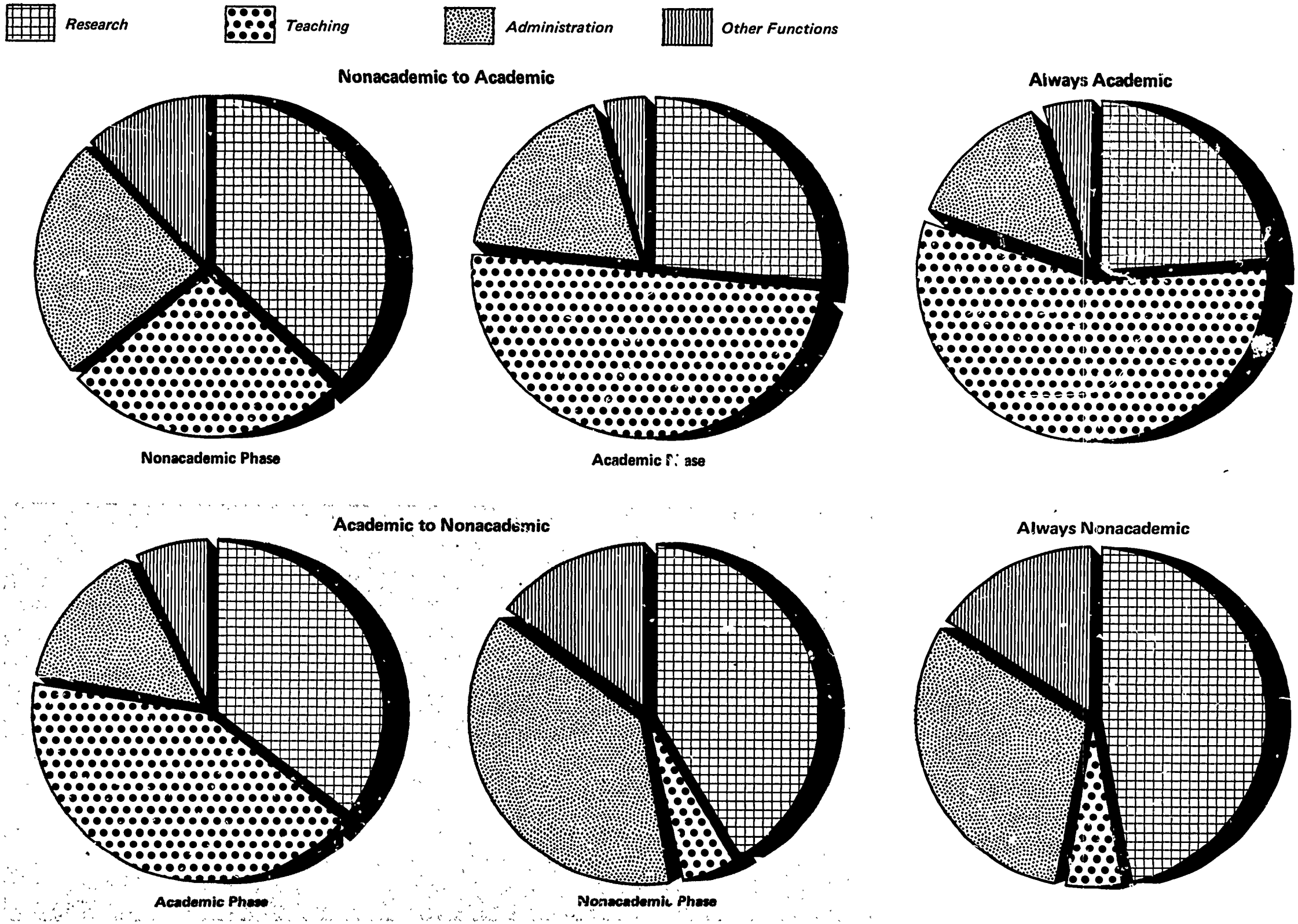
The Switch Picture

Figure 16 gives a general introduction to this question; it shows functional distributions for the four main experience groups, with a further breakout of those who switch from academic to nonacademic jobs, or vice versa, on a before and after basis. The data from which Figure 16 was drawn include all fields and cohorts and a combination of all relevant time periods. The top right-hand circle includes the entire careers of the large group of people who were always in academic employment. The bottom right-hand circle similarly portrays those who were never in academic employment. At the upper left are those who switched from nonacademic to academic employment, before and after the switch. At the lower left are those who switched from academic employment to nonacademic jobs, also on a before and after basis. The colored figures represent academic employment; the gray ones represent nonacademic employment. The proportions of time devoted to the four main functions of teaching, research, administration, and all other functions are shown as segments of a circle. As expected, those always in academic jobs spend a major portion of their time in teaching functions and about one fourth in research, whereas those always in nonacademic jobs spend almost half their time in research, about one third in administration, and only a tiny fraction of their time in teaching functions. Chief interest, however, centers on those who switch from one employer category to another, as their time distributions, before and after the switch, do not correspond entirely to those of the people who never switch.

Teachers and Researchers

The people who started out in academic jobs and later switched to other types of employers were, prior to switching, spending more time in research than were those who remained in academe. Their switch gained them relatively little in research time, but a great decrease in teaching, with a marked expansion in time devoted to administration and other functions. Those who started out in nonacademic jobs and later switched were doing much more teaching than is typical in the nonacademic category. In switching, they gained still more teaching and a decrease in administrative and other functions. It would appear from these two observations as if a desire for more teaching or to get away from teaching was a powerful influence in bringing about the change in employer category. However, Figure 16 gives only a rather rough first approximation, and a more detailed look at the data is necessary to examine the situation immediately before and immediately after a switch, at various time periods.

FIGURE 16
Functional Time Distribution of PhD's by Experience Group, All Fields and Cohorts Combined



Focus on Choice Points

A somewhat more detailed picture of the time distribution percentages before and after switching is furnished by Table 14, which combines the data for Cohorts 1 and 2, including all fields, for the time periods 1940 through 1963. The data for Cohort 1 alone are reported in Appendix Table C-2. In each time period six groups are shown: those who remained in academe throughout, those who remained in nonacademic employment throughout, and the two groups of those who shifted in either direction. Those in academic employment are shown in color, those in nonacademic employment categories in black. The shift groups are subdivided into those who have just shifted and those who were about to shift by the next time period. Each successive box, as one reads down the page in the shift group columns, represents a different subgroup of those who shifted. In this way, Table 14 highlights the situation at the choice point. Data for those who just shifted are not available for 1940, as the 1940 cohort was still in graduate school in the previous time interval. The "about to shift" group is of course omitted from the 1963 period, as one does not know who might shift in the future.

TABLE 14

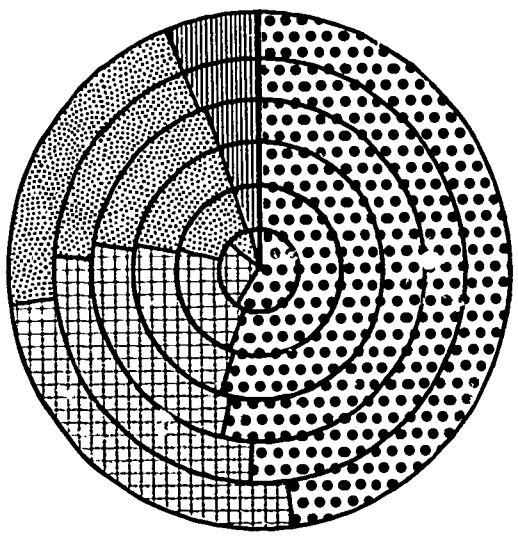
Percentage Time Distribution among Teaching, Research, Administration, and Other Functions, by Year and Experience Group, Average of Cohorts 1 and 2

			PERCENTAGE OF PHD'S BY EXPERIENCE GROUP					
		ALL EXPERIENCE GROUPS COMBINED	NONACADEMIC TO ACADEMIC[a]			ACADEMIC TO NONACADEMIC[a]		
YEAR	FUNCTION	(%)	ABOUT TO SHIFT	JUST SHIFTED	ALWAYS ACADEMIC	ABOUT TO SHIFT	JUST SHIFTED	ALWAYS NONACADEMIC
1940	Teaching	45.4	15.6	—	66.6	52.4	—	6.9
	Research	33.2	32.2	—	21.7	37.8	—	55.4
	Administration	13.0	30.6	—	8.4	7.3	—	20.0
	Other	8.5	21.8	—	3.5	2.6	—	17.8
1945	Teaching	35.2	5.2	53.2	58.8	47.9	6.8	6.0
	Research	31.6	41.3	17.8	21.6	36.3	51.6	42.9
	Administration	22.7	38.9	19.6	14.3	9.4	24.7	34.9
	Other	10.6	14.7	9.5	5.4	6.5	17.0	16.3
1950	Teaching	36.2	12.0	53.7	54.6	59.1	2.8	6.0
	Research	28.6	36.5	22.7	21.8	18.7	47.4	38.7
	Administration	26.8	35.1	19.8	18.8	11.9	35.5	39.8
	Other	8.5	16.4	4.0	4.9	10.4	14.5	15.6
1955	Teaching	33.2	3.0	45.0	51.7	35.5	7.0	5.9
	Research	26.8	32.2	33.0	21.5	28.6	27.7	32.5
	Administration	31.1	56.2	16.9	22.1	27.6	39.1	45.9
	Other	9.0	8.7	5.2	4.9	8.4	26.3	15.7
1960	Teaching	32.7	17.5	47.8	49.5	32.0	3.1	5.9
	Research	24.0	30.1	17.2	20.3	18.5	28.5	28.2
	Administration	33.8	40.3	27.7	25.5	47.3	30.2	51.4
	Other	9.7	12.2	7.4	4.8	2.2	38.3	14.6
1963	Teaching	31.9	—	48.0	48.1	—	11.1	5.1
	Research	24.0	—	24.8	21.0	—	32.5	26.8
	Administration	34.2	—	25.1	25.9	—	41.2	53.2
	Other	10.0	—	2.2	5.1	—	15.3	15.1

[a]The data for each year (1940 to 1963) include a different subgroup of those who switched from nonacademic to academic and academic to nonacademic.

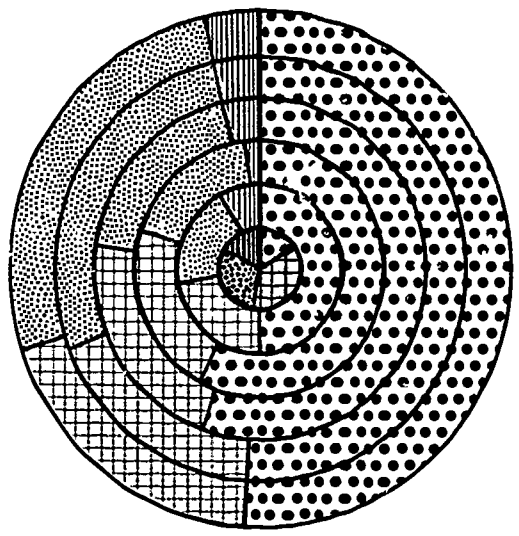
FIGURE 17
Functional Time Distribution of PhD's from 1940 to 1963 by Experience Group, All Fields and Cohorts Combined

Always Academic

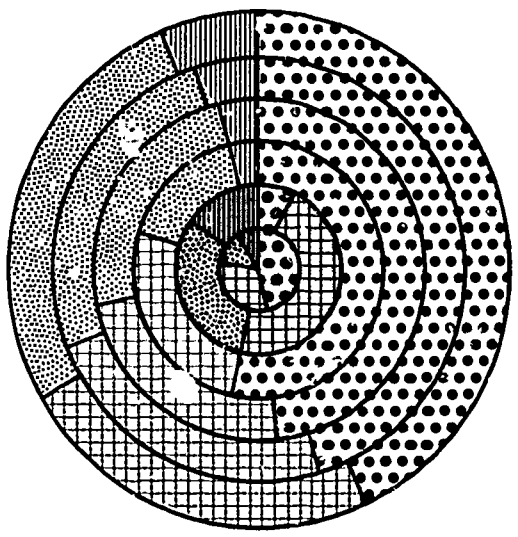


Nonacademic to Academic
Subgrouped by Time Period of Shift

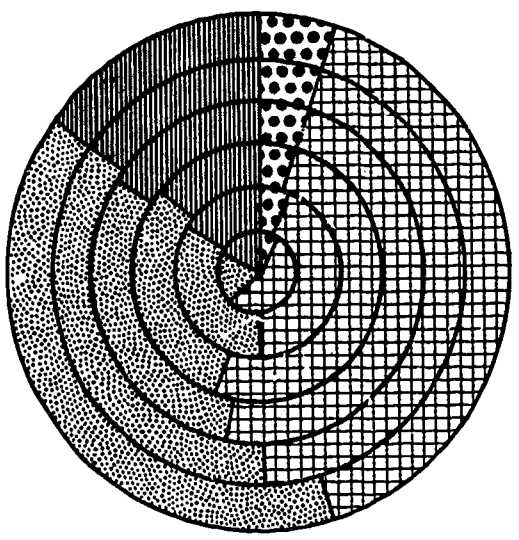
1940 to 1945



1945 to 1950

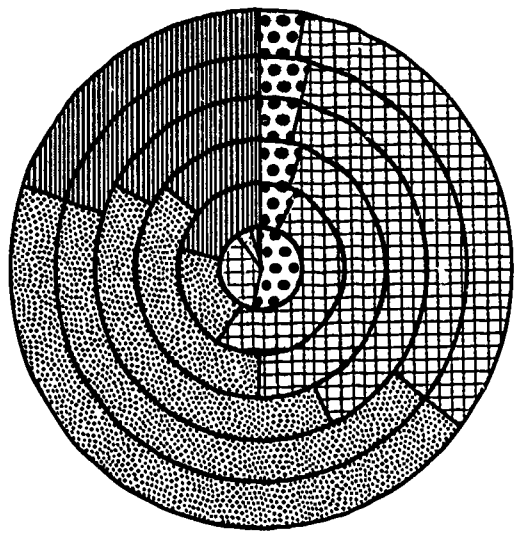


Always Nonacademic

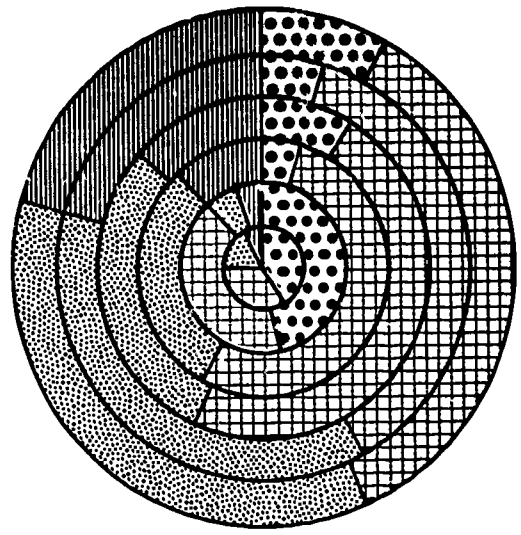


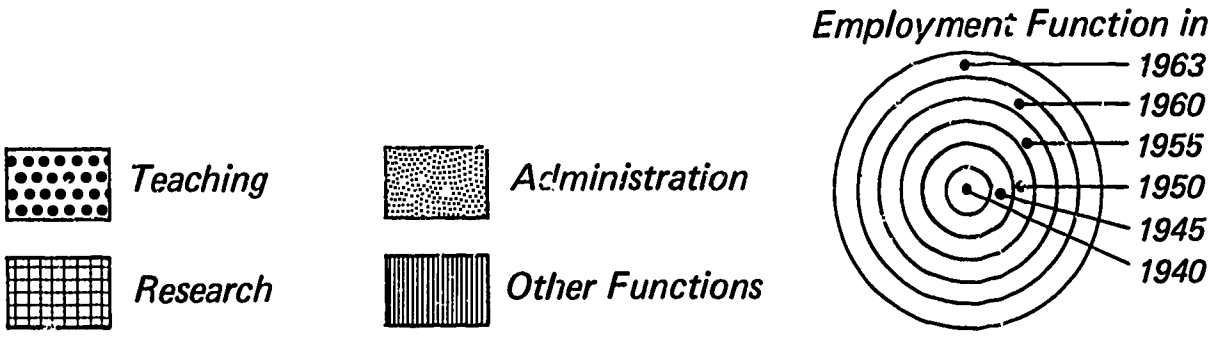
Academic to Nonacademic
Subgrouped by Time Period of Shift

1940 to 1945

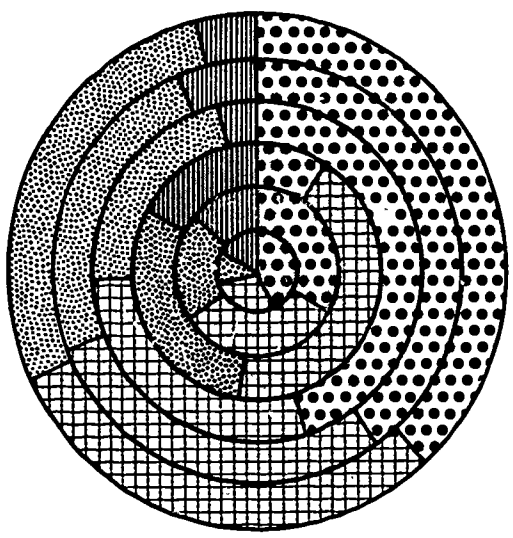


1945 to 1950

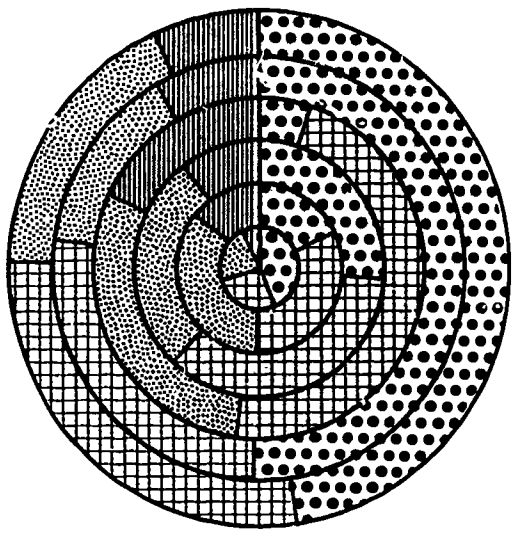




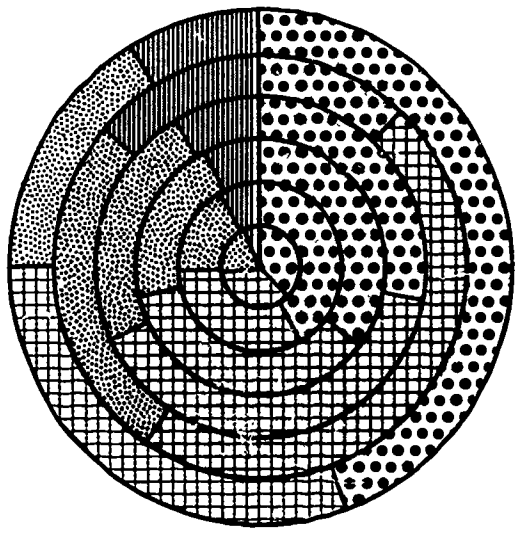
1950 to 1955



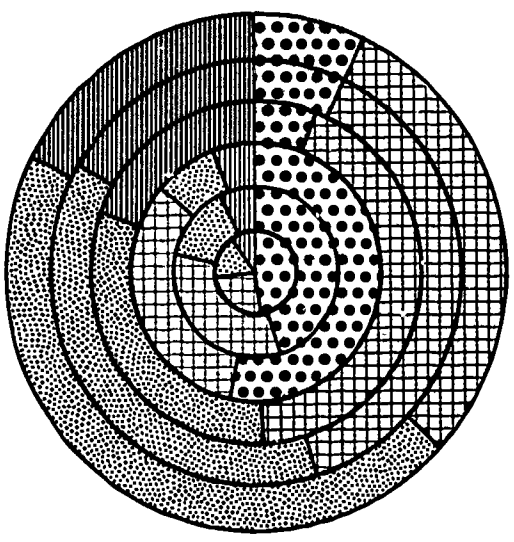
1955 to 1960



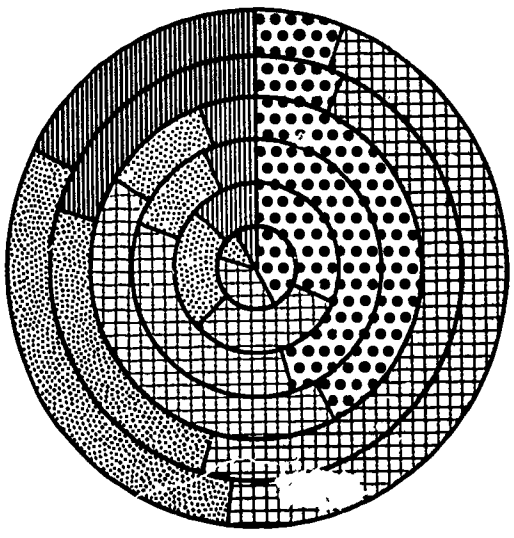
1960 to 1963



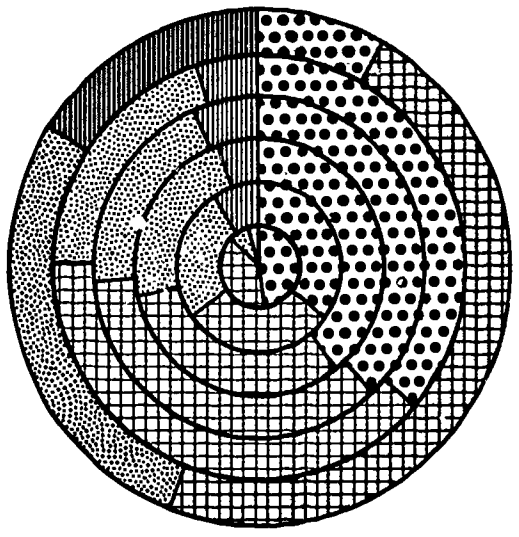
1950 to 1955



1955 to 1960



1960 to 1963



By scanning down the columns of those who did not shift employer category, it may be noted that they did less and less teaching as time progressed, although this change was not drastic for the always-academic group after the first two time periods. Using this group as a standard, the teaching load for those who did shift may be examined for evidence of the importance of teaching in the shift groups. Similarly, the amount of time devoted to research, by those who did not shift employer categories, may be used as a reference yardstick. The always-academic group, for these two cohorts, spends just over one fifth of its time in research, in each time period. The always-nonacademic group begins by spending over half of its time in research, but this proportion declines progressively, as administrative duties become heavier, to just over one fourth by 1963.

A more detailed picture of the interrelations of experience group, time distribution, and career development stage is provided by Figure 17, in which career developments are depicted as analogous to growth rings on cross sections of tree stems. These diagrams include all fields and cohorts. The 1940 job is shown as the smallest ring at the center of each section; successive periods are shown as additional rings, out to 1963. The four functions of teaching, research, administration, and other activities are shown by the same patterns as in Figure 16. The periods in which the people were in academic employment are shown with a brown tint; those periods in other employment are shown as a gray shade. The twelve experience groups are sorted according to employer category in 1963; those in academic employment at that time are in the top row; those in nonacademic employment in 1963 are below. At the left are the diagrams for those who did not change employer category. Those who shifted at successive time periods are arrayed to the right, according to period of shift.

Status Quo Ante

The first general impression in examining this set of time-distribution patterns is that there is a great deal of similarity among all the periods with the same color tint—either academic or nonacademic. Teaching is prominent in all the brown-tinted circles and is relatively infrequent in the gray-shaded circles. Yet the variations from this generalization are of interest and are probably significant as indications of reasons for change in employer category. Attention is best focused on the period immediately prior to a change in employer category and on the time distribution in this period as compared with those that preceded it. For a more precise examination of the changes, as compared to the impressionistic data furnished by the diagrams, see Table 15. Here are the same data in numeric form, with the periods in the academic portion shaded in brown for quick reference.

In Table 15 the time periods are arrayed vertically, as in Table 14. The full set of switch groups is included in Table 15, whereas in Table 14 (which included only Cohorts 1 and 2) the data were given only for the particular group that switched at each specified interval. In Table 15, the first column within each block of those who shifted employer category is for those who shifted between 1935 and 1940. Obviously, these are the oldest people in the table, as this column includes Cohort 1 only. Successive columns to the right include Cohorts 2, 3, 4, 5, and 6. The last column within each block represents all cohorts, but is heavily weighted with the more recent graduates who have not settled down as much as have their older colleagues. This age difference, or variation in "cohort mix" as we go from column to column in Table 15, must be kept in mind in interpreting the amount of time devoted to each function within a given year. The always-academic and always-nonacademic groups, Cohorts 1 and 2 of which are also in Table 15, are repeated here with all cohorts included. In Table 15, however, the percentages are rounded to the nearest whole number, and thus may not total to 100%.

TABLE 15

Functional Time Distribution of PhD's by Experience Group at Five-Year Intervals, All Fields and Cohorts Combined

		PERCENTAGE OF PHD'S BY EXPERIENCE GROUPS												
		NONACADEMIC TO ACADEMIC							ACADEMIC TO NONACADEMIC						
		TIME PERIOD OF SHIFT							TIME PERIOD OF SHIFT						
YEAR	FUNCTION	1935 to 1940	1940 to 1945	1945 to 1950	1950 to 1955	1955 to 1960	1960 to 1963	ALWAYS ACADEMIC	1935 to 1940	1940 to 1945	1945 to 1950	1950 to 1955	1955 to 1960	1960 to 1963	ALWAYS NONACADEMIC
1940	Teaching	53	17	47	43	44	38	67	3	53	43	49	45	48	7
	Research	30	36	31	30	28	35	22	50	38	40	25	33	41	55
	Administration	10	26	13	10	23	21	8	24	6	10	15	14	8	20
	Other	7	21	10	18	6	6	4	22	3	7	12	9	3	18
1945	Teaching	37	51	7	32	19	41	59	3	6	47	45	31	35	6
	Research	32	21	46	34	32	34	22	44	53	40	34	32	29	43
	Administration	14	19	32	20	35	17	14	38	21	7	15	24	27	35
	Other	17	9	15	14	14	8	5	14	20	6	7	14	9	16
1950	Teaching	50	58	53	9	26	35	57	3	5	5	53	45	39	5
	Research	28	21	26	43	36	37	24	36	45	53	33	36	32	30
	Administration	17	18	17	31	27	22	15	53	35	30	8	13	24	31
	Other	5	3	4	17	11	7	5	8	15	13	6	6	5	14
1955	Teaching	48	56	48	45	5	28	54	4	4	9	6	42	38	5
	Research	27	21	24	29	47	40	25	34	39	48	43	42	35	47
	Administration	19	20	24	22	30	24	15	54	40	30	31	11	21	32
	Other	6	4	4	4	18	8	5	8	17	14	19	5	6	16
1960	Teaching	45	51	45	40	50	12	51	4	4	5	7	7	36	5
	Research	30	18	24	29	28	48	27	34	31	38	38	47	39	44
	Administration	19	27	26	25	15	26	17	52	45	37	38	26	20	36
	Other	6	4	5	6	8	14	6	11	20	21	17	20	5	15
1963	Teaching	42	51	43	38	48	44	48	4	3	8	7	6	8	5
	Research	33	19	24	30	28	31	26	34	32	35	30	45	47	40
	Administration	20	26	27	28	17	17	20	48	45	36	45	31	29	41
	Other	6	4	6	4	7	8	6	13	20	21	18	17	16	15

A Yen to Teach?

Coming down the block for the nonacademic-to-academic group in Table 15, it is notable that there is a great deal of time spent in teaching by those in nonacademic employment in all time periods other than that immediately preceding a switch to academic work. For example, at the top of the column for those who switched between 1940 and 1945, the group spent 17% of its time in teaching. The other nonacademic groups in this block spent 38% to 47% of their time teaching in 1940. In each preswitch period, the teaching percentage drops from 26% or more to 12% or less, the average drop being 25 percentage points. In periods other than that immediately preceding a switch to academic work, the proportions of time in teaching range from 19% to 47% and average 35%. These figures are consistent with the supposition that they represent people who enjoy the teaching function and who, when they are no longer able to perform this function in nonacademic settings, switch to settings where teaching is the norm. The opposite phenomenon, that of seeking to avoid teaching, might be hypothesized for those who switch in the opposite direction. Coming down the academic-to-nonacademic block of Table 15, we observe a very large proportion of time

spent in teaching (from 36% to 53% averaging 46%) in the period immediately preceding the switch to nonacademic work. In the immediate postswitch period, the time spent in teaching, for these groups, is never over 8%. Time in teaching remains low, never going over 9% and averaging 5% in the later periods.

More Yen to Administer?

Typically, those in nonacademic employment spend more time in research than do those in academic settings. Yet, observing the comparable time periods for the pairs of switch groups, coming down the columns of Table 15, it is notable that those in academic settings who switch to nonacademic employment do more research in the same time periods than do those in nonacademic jobs who later change to academic work. In each instance, those who switch from academic to other work, even though they were doing more research at the time than their academic colleagues, do still more, by a sizeable percentage, when they switch out of academe. The change in their time distribution which is most notable, however, is the enormous increase in administrative functions. The average jump in administrative time is from 10% while still in academic positions to 27% in the immediate postswitch period, with further increases to follow, up to approximately half-time spent in administration in the later periods. For comparable time periods, those who switch into nonacademic employment from academe do more administration and less research than those who began in nonacademic work in the first place and stayed there throughout their careers.

Facts and Inferences: A Summary

The people in this study were not asked their reasons for changing employer categories; one can only make inferences from the record of what they did prior to and after switching jobs. We have seen earlier that by switching from academic to nonacademic jobs people typically gained considerably in income. Now we note that this switch is typically one to more administrative and research activity and not infrequently to a combination of administration and research, the job–activity combination which is associated with the highest salaries. On the other hand, a switch from nonacademic employment to academic work was accompanied by a decrease in rate of income growth. We now note, quite according to expectation, that this involves a marked increase in teaching time. The unexpected finding, however, is that even in their nonacademic jobs the people in this latter group were spending a considerable portion of their time in teaching functions. A desire to teach—or to avoid teaching—therefore appears to be a factor, at least partly independent of salary, that affects career decisions.

HOURS WORKED PER WEEK

For the entire sample, the average number of hours worked per week is reported as 47. The academic group reports, on the average, about four more hours per week than does the nonacademic group. The problem of definition is crucial here. Typically, in nonacademic work, the number of hours can be counted on a portal-to-portal basis. But this is not true of academic jobs, where the "contact hours" are only a minor fraction of the total, and there is no fixed schedule for the remainder nor any clear line separating "work" from other activity. Time spent reading a professional journal at home is likely to be counted as "hours worked" by the academic man, but is less likely to be so counted by the nonacademic man. In spite of this limitation, the data are of interest as a kind of reflection of the way these two groups perceive their jobs. Table 16 provides the essential data. Line 1 gives the figures for the always-academic group and line 3 for the always-nonacademic group; these figures show that each of these groups reports a fairly constant number of hours over a span of 15 years. Lines 2 and 4 give the average reported hours for those who switch and show that both groups, prior to the switch, had work weeks intermediate between those of the two groups that did not switch. The time of switch is here aligned with time of graduation, and hours reported 5, 10, and 15 years after the switch are com-

TABLE 16

Average Number of Hours Worked per Week Reported at Five-Year Intervals, by Experience Groups

EXPERIENCE GROUP	AVERAGE NUMBER OF HOURS				
	5 YRS BEFORE SWITCH	IMMEDIATELY AFTER PHD OR EMPLOYMENT SWITCH	5 YRS LATER	10 YRS LATER	15 YRS LATER
Always Academic		49.0	49.6	49.7	49.6
Nonacademic to Academic	46.0	47.6	48.6	49.1	49.5
Always Nonacademic		44.4	45.3	45.2	44.8
Academic to Nonacademic	47.8	47.1	44.9	43.8	43.9

pared with those reported 5, 10, and 15 years after graduation for the other groups. These data are shown graphically in Figure 18. It is apparent that both groups report, over a period of 15 years, a gradual trend toward the typical hours of the new group with which they have become affiliated, reversing their relative positions in the period prior to the switch.

There are some field variations, but they do not justify a separate table, as they seem to reflect principally the field variations in percentage in academic employment. In the biosciences, as in the entire sample, two thirds of all employment is academic and the average hours worked per week is 47. In the social sciences and the humanities, arts, professions group, where three fourths of the jobs are academic, the average is higher by about one or two hours per week. Only half of the jobs in the physical sciences are academic, and the average work week is reported to be about one hour shorter than for the entire sample.

One might summarize by saying that the reported number of hours worked per week, while a bit ambiguous, does reflect a difference in job perception by the academic and nonacademic doctorate-holders, with the academic people rather consistently reporting a work week longer by about four hours than that of the nonacademic people and with very slight shifts over time for either group. Changes reported by those who shift employer categories make them resemble their new colleagues.

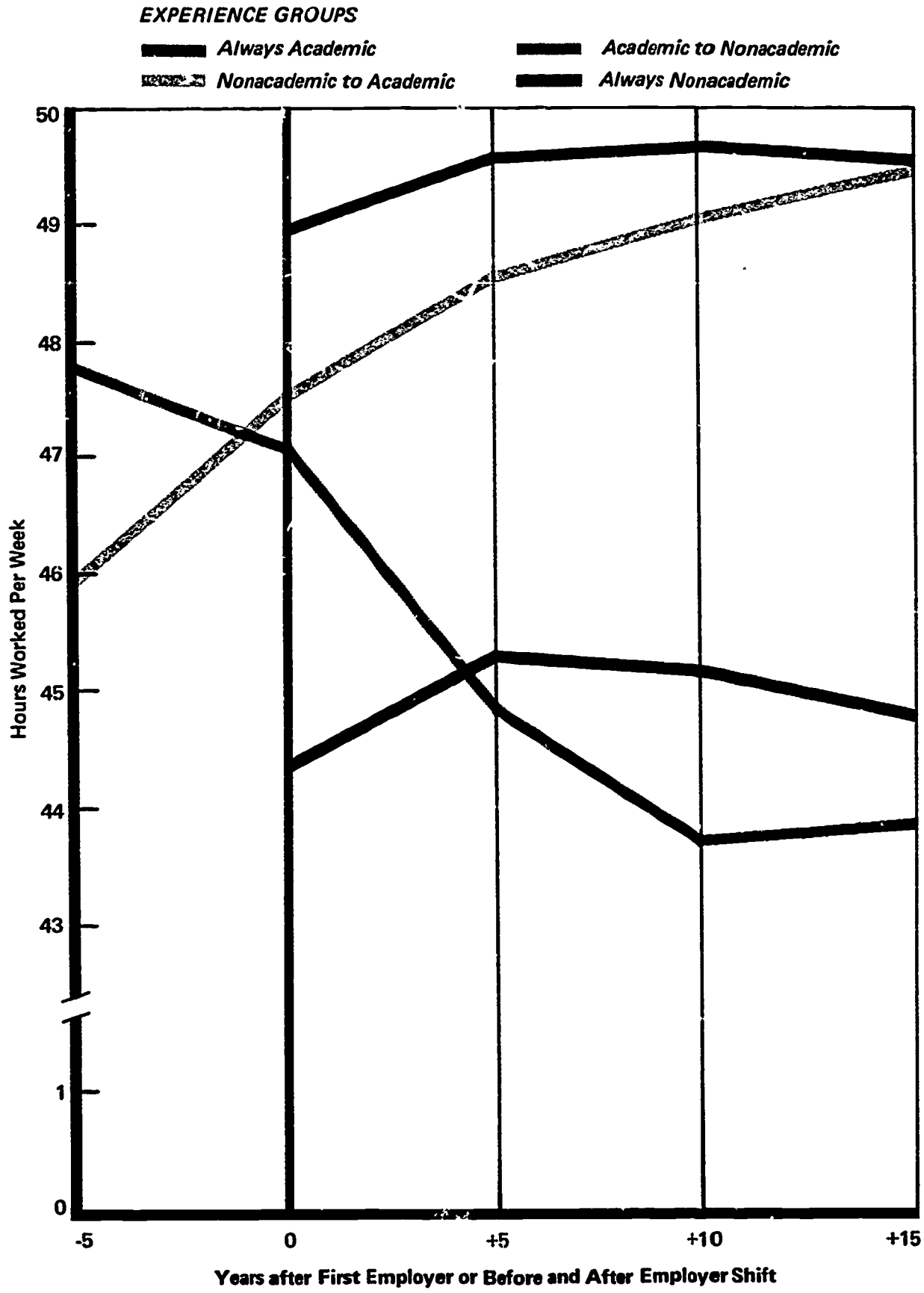
CHANGES IN FIELD OF SPECIALIZATION

In general, as one expects, people shift less from one field of specialization to another as their careers mature. As was shown in the previous report,* those with strong research commitments tend to stick most closely to a particular field. Those data combined all employer categories. In this report, field-change data are related to employer category and to change in employer category, in an attempt to discover whether there is any functional relationship.

An effort was made to develop a quantitative index of field-switching which would take into account not only the number of people who switched fields but also the kind or extent of the switches that were made. Some switches are rather minor, or more a matter of terminology than substance, such as some from biochemistry to physiology. Others are major switches, taking one clear out of his original field. However, none of these efforts yielded unambiguous or clearly definable results, and even the most promising were essentially circular, such as

*Lindsey R. Harmon, Profiles of Ph.D's in the Sciences, Chap. 5, NAS–NRC Publ. 1293, Nat. Acad. Sci.–Nat. Res. Council, Washington, D.C., 1965.

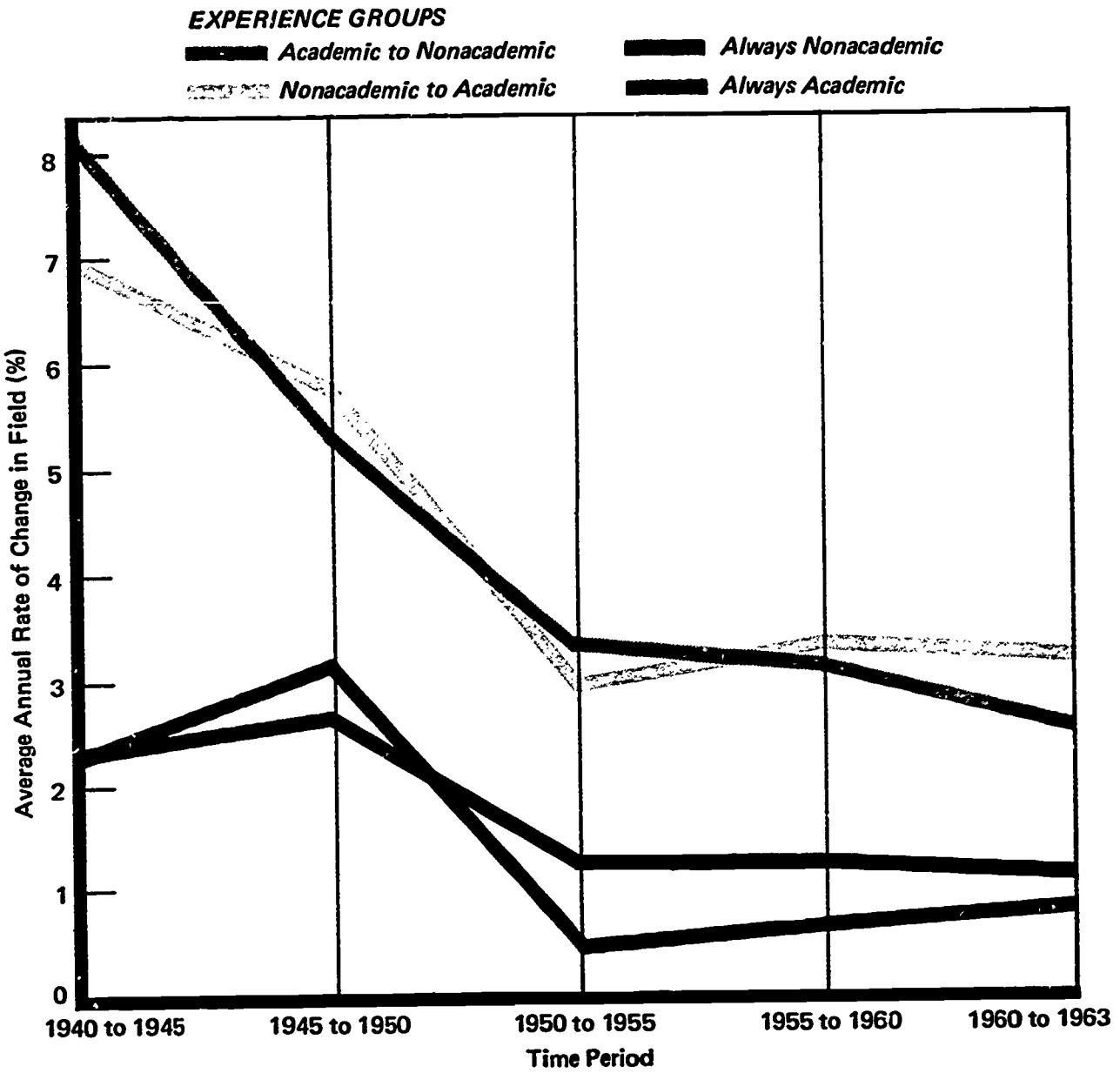
FIGURE 18
Average Number of Hours Worked per Week, by Experience Group, at Five-Year Intervals



defining the degree of switch in terms of the inverse of the frequency with which it could be successfully accomplished. Eventually, it was decided to use a simple dichotomous scale: whether one moved from one to another of the original 24 fields described in the previous report. This was found to be quite useful and was quantified, as the percentage changing in any period divided by the number of years in the period, to yield an annual percentage rate of shifting for any group. The results are described below.

Figure 19 shows the rate of field-switching for each of the four experience groups. The cases included here are limited to those actually employed in both time periods being compared—field of specialization for the doctorate is not included. It is apparent at a glance that those who do not change employer category have much lower rates of field-switching than those who switch to or from academe at some point in their careers. Those always in academic work start at

FIGURE 19
Average Annual Rate of Change in Field of Specialization, by Experience Group and Time Period



exactly the same point as those never in academic work; their rate goes up slightly higher at the end of World War II and thereafter declines sharply to less than 1% per year. The slight rise in the most recent periods is a function of the admixture of younger people, with greater shifting rates, as the data in this graph include all cohorts, and the later cohorts are more populous. The never-academic group also shows a decline after the end of World War II, to a steady annual rate of about 1.3%. The difference between these two groups is probably statistically reliable, but not large enough to be of any great importance, as both rates are very low.

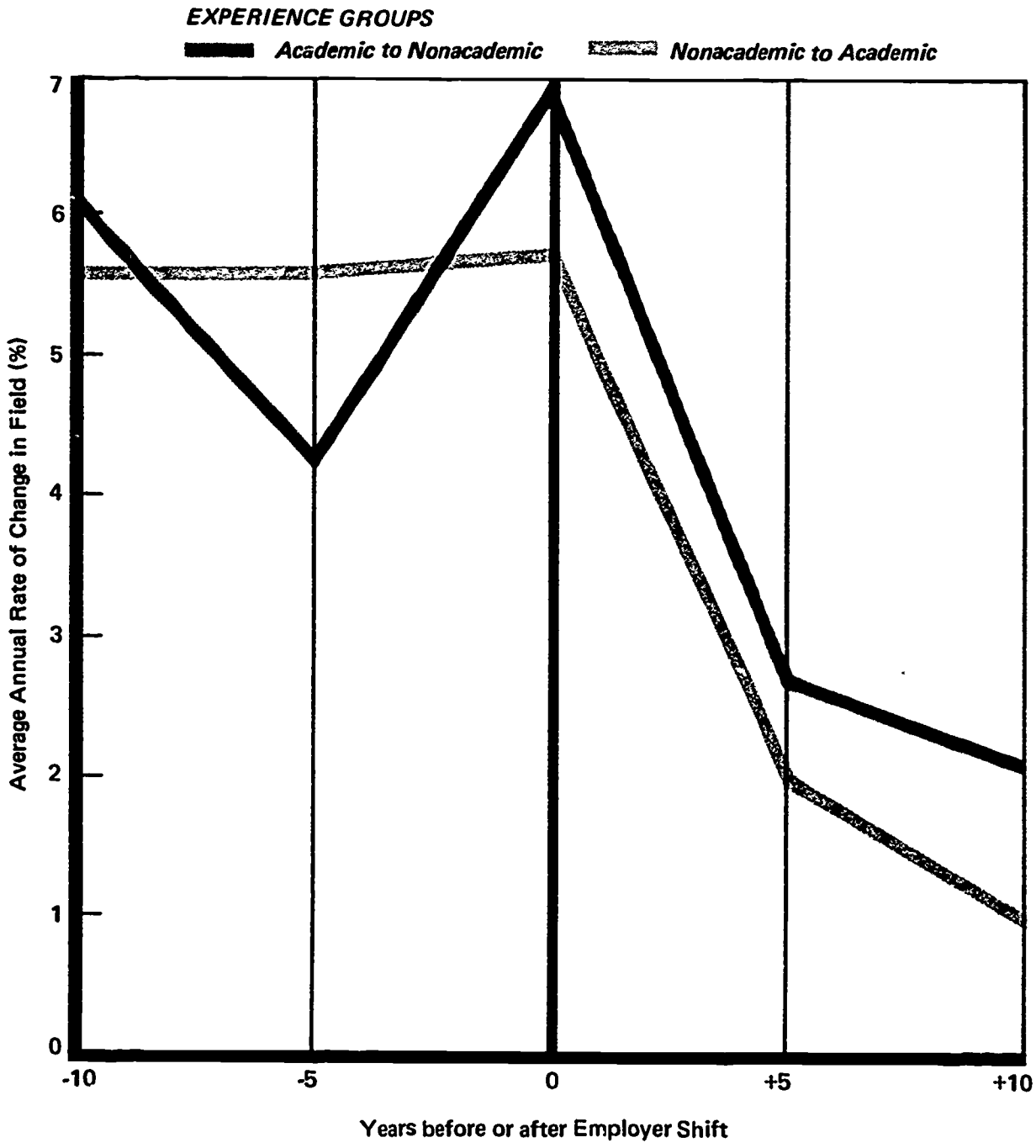
Those who changed employer categories had a much higher rate of field-switching. Eight percent of those who began in academic jobs and later switched to nonacademic employment (group AN) changed fields each year during the World War II period. This rate dropped thereafter, to 5.4% in 1945–1950 and to 3.4% in 1950–1955, then more slowly to 2.6% in the 1960's. Those who began in nonacademic positions and later switched to academe had a similar experience, their switch rate dropping progressively from 7% per year in the war years to 5.8% in 1945–1950, to 3.0% in 1950–1955, and remaining relatively stable thereafter. As a rule of thumb, those who changed employer categories were also more apt to change fields, by a factor of two or three times as frequently as those who did not change employers, at equivalent career stages.

Figure 19 combines the data of those who change employer categories at various stages. The functional relationship of employer change to field change requires that the data be sorted differently, according to whether the data are from before or after the employment shift, or coincide with it. The data neces-

sary for this evaluation are illustrated by Figure 20, in which rate of change five and ten years prior to the employment shift, five and ten years after it, and at the point of shift are shown. It is clear from Figure 20 that there is a functional relationship. Prior to the employer category shift, those in nonacademic employment (group NA) had an annual rate of field-switching of 5.6%. In the five years after the shift to academe this rate dropped to 2% per year, and ten years later it had declined to 1% per year—almost as low as for those always in academic jobs. Those who began in academe (group AN) were equally restless before the shift; their rate of field-switching reached a peak at 7% per year in the period in which they shifted to nonacademic employment. Five years later it had dropped to 2.8% per year, and ten years later to 2.1% per year. Even at this low point it is close to twice the rate of change of those in the other experience groups.

As with the other variables, this field-switching item, standing alone, is rather difficult to interpret. It may be that the academic life tends to perpetuate a particular field of specialization for an individual just as it does for general academic fields or departments. In the business and industrial world, and in government service, too, there are probably more incentives to change. This could account for the minor, but rather consistent, differences between the always-academic and always-nonacademic groups and likewise for the differences between those who switch into and out of academic employment. It cannot, however, account for the difference between the switch groups and those who never switch. This latter difference may be merely a matter of the circum-

FIGURE 20
Average Annual Rate of Change in Field of Specialization for Nonacademic-to-Academic and Academic-to-Nonacademic Groups, by Years before and after Employer Shift



stances of the lives of the individuals involved, or it may reflect some important inherent differences between the two groups of people themselves. As to the relative importance of these two sources of variation, the present data furnish no adequate clues.

GEOGRAPHIC MIGRATION

The migration of PhD's in the career patterns sample was described extensively in the earlier report, Profiles of Ph.D's in the Sciences. In brief, it was found that the Midwest, which produced 40% of the PhD's, employed only 25% of them in 1963; the South, which produced 12%, employed 24%; the West, which also produced 12%, employed 18%; New England, which produced 13%, employed 7% in 1963; the Middle Atlantic states came out about even, producing 22% and employing 20%. In the present report, the main objective was to explore the relationship between migration and change in employer category. It was clearly impossible to study all the interregional changes in terms of change in employer category, as the number of such combinations was too great for statistical reliability. On the other hand, interregional changes were still too gross to reflect some important aspects of the problem. What was needed was a metric which provided a measure of the degree of geographic shift by taking into account shifts within a state, across state lines, across regional lines within the United States, and across national boundaries. Table 17 provides data on the amount of shift-

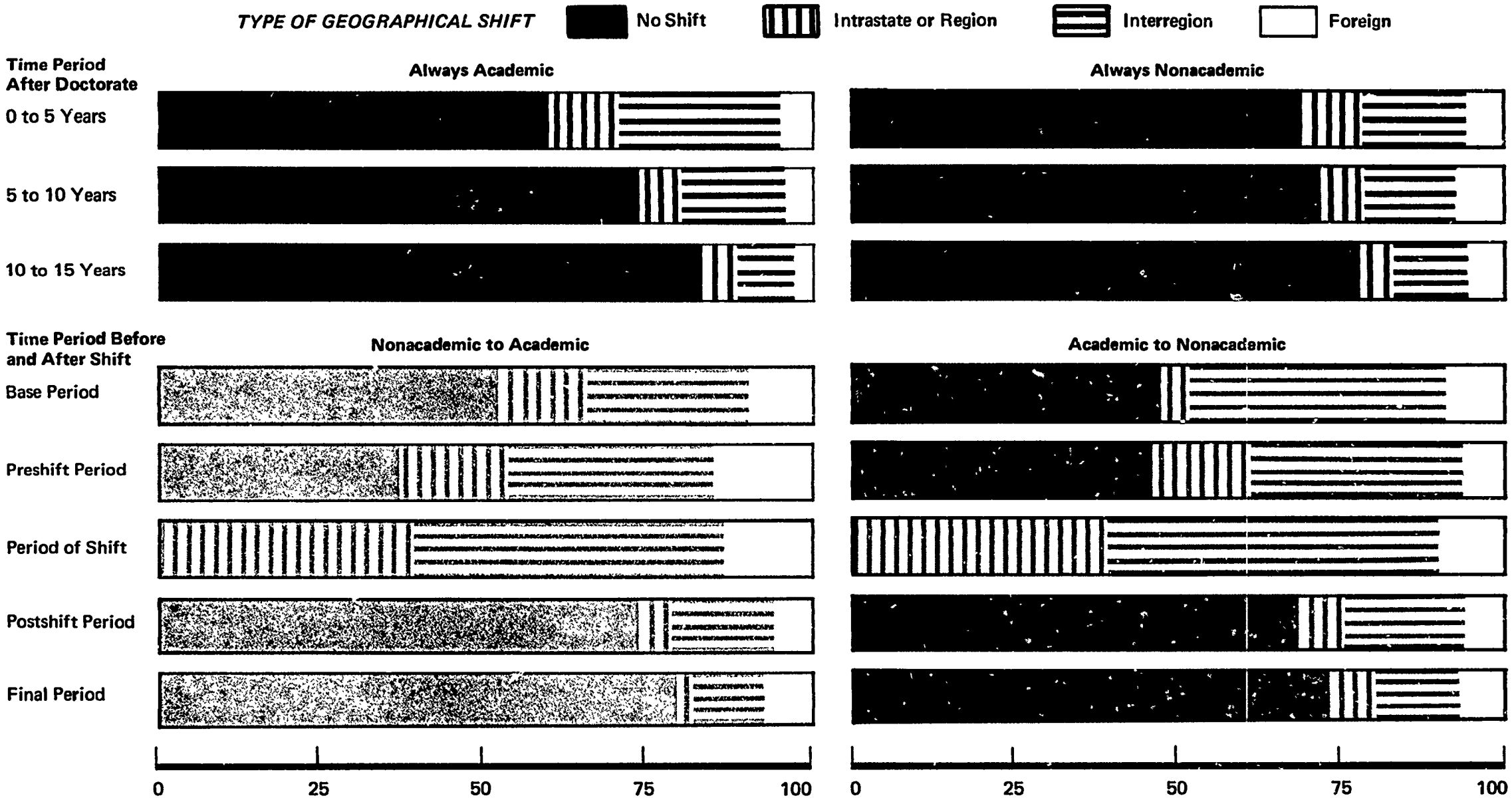
TABLE 17

Geographic Shift of PhD's by Experience Group, at Five-Year Intervals after PhD Graduation or Prior and Subsequent to Employment Shift, All Fields and Cohorts Combined

			PERCENTAGE MAKING EACH GEOGRAPHIC SHIFT					
EXPERIENCE GROUP	DESCRIPTION OF INTERVAL	TOTAL	0 NO CHANGE	1 CHANGE WITHIN STATE	2 CHANGE OF STATE BUT NOT REGION	3 CHANGE OF REGION	4 CHANGE TO FOREIGN COUNTRY	5 CHANGE BETWEEN FOREIGN COUNTRIES
Always Academic	Years Since PhD							
	0–5	100	61	4	6	24	2	3
	5–10	100	74	3	3	16	1	3
	10–15	100	83	2	2	10	1	2
Nonacademic to Academic	Base Period[a]	100	52	6	7	26	3	6
	Preshift Period	100	37	9	7	32	10	5
	Period of Shift	100	0	28	12	47	10	3
	Postshift Period	100	74	2	3	15	1	5
	Final Period	100	79	2	2	10	2	5
Always Nonacademic	Years Since PhD							
	0–5	100	69	3	5	17	2	4
	5–10	100	72	3	4	14	2	5
	10–15	100	78	2	3	11	2	4
Academic to Nonacademic	Base Period[a]	100	47	6	8	31	3	5
	Preshift Period	100	46	8	8	32	2	4
	Period of Shift	100	0	25	14	52	6	3
	Postshift Period	100	68	5	5	16	2	4
	Final Period	100	72	3	5	13	3	4

[a]Definitions of periods for groups Nonacademic to Academic and Academic to Nonacademic:
Base Period: That interval from 10 years prior to the period of shift to 5 years prior to the period of shift.
Preshift Period: That interval immediately preceding a change in employer category.
Period of Shift: One employer category at the beginning of the interval, the other at the end.
Postshift Period: The 5-year interval next after the period of shift, with same employer category throughout.
Final Period: The second 5-year period after the period of shift.

FIGURE 21
Types of Geographic Shift of Career Patterns Experience Groups, All Fields and Cohorts Combined



ing by each of the experience groups, combining all fields and cohorts. For the always-academic group, and the always-nonacademic group, the shifts in the 15 years subsequent to receipt of the doctorate are given. For the others, the relevant periods are those preceding and following change of employer category. To provide a reasonable degree of stability to the data, the periods up to 10 years prior to the period of shift in employer category, and 10 years subsequent to the shift period are given. Figure 21 depicts graphically the proportion of each experience group that made each of the types of shift during each relevant five-year period. To simplify the graph, all intrastate shifts were combined, as were all shifts involving a foreign country.

As might be expected, shifting decreases with time. The always-academic group shows decreases in each shift category throughout the three intervals depicted, and an increase in the size of the group that does not move geographically, from about 60% to about 80% over this time period. The always-nonacademic group moved less in the first postdoctoral time interval but did not settle down to as great a degree as did the academic group; its various types of geographic shift are greater than those of the always-academic group 10 to 15 years after the PhD. With both the nonacademic-to-academic group and the academic-to-nonacademic group, there is a sharp decrease in geographic shifting after the switch in employer category; prior to the switch, each of these groups had been much more restless than those who did not change employer category. After the switch, they resemble the AA and NN groups as of 10 to 15 years after the doctorate.

A Geoshift Index

The same general effects can be examined with greater precision, and somewhat more satisfactorily, by computing a single index to quantify the degree or amount of geographic shift. What we will call a geographic shift index was calculated for each individual, using the following scale applied to each successive pair of five-year intervals:

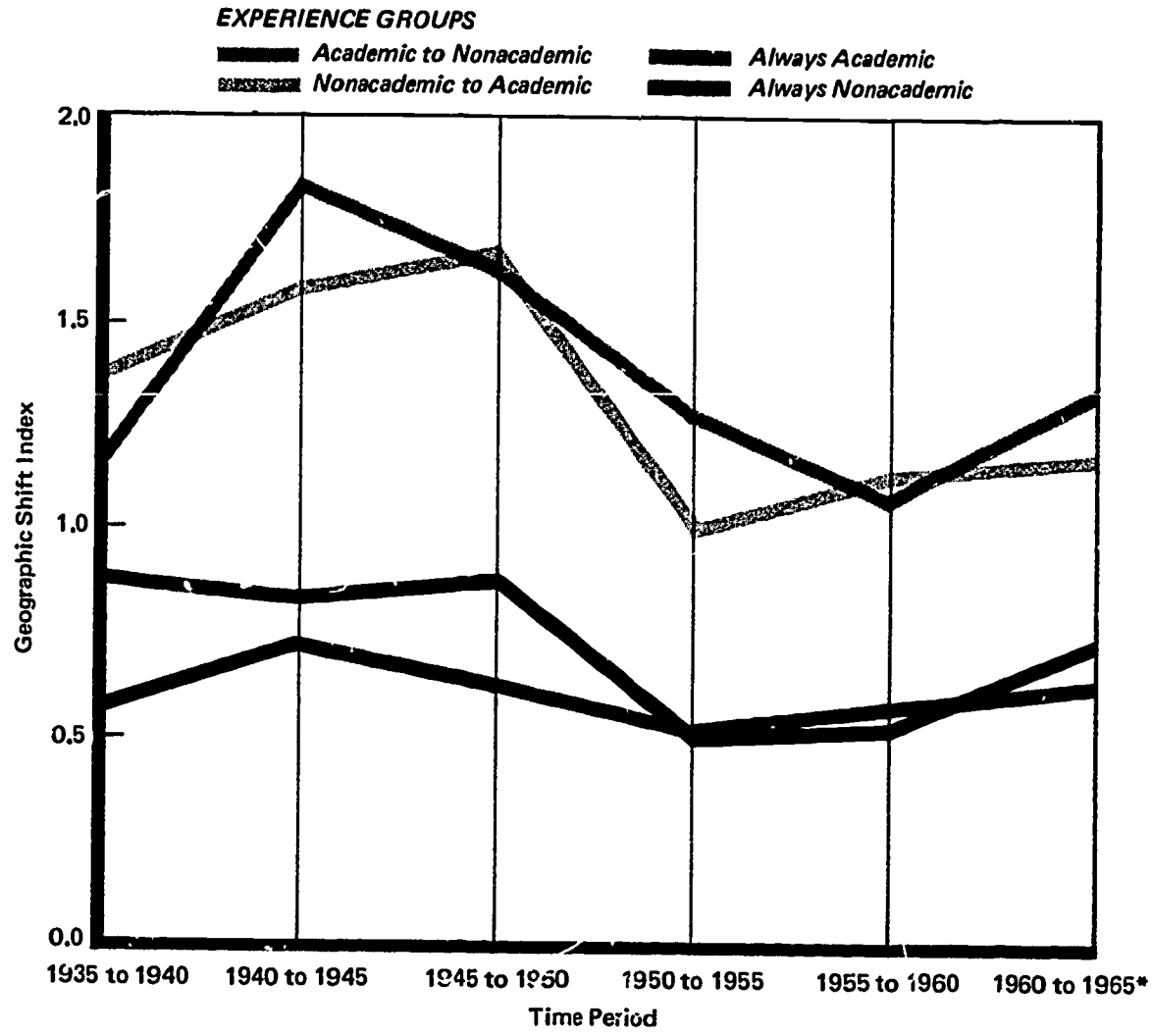
0, no employer change
1, employer change within state
2. change outside of state but within region
3, change outside of region but within the United States
4, change between the United States and a foreign country
5, change between two foreign countries

This scale may be applied to a group by averaging the indices for all the members of the group. It should be noted that a high group index can be obtained by either of two routes: a large proportion making short moves or a small proportion making long moves. This degree of definition, present in Figure 21, is lost in the geoshift index.

When all fields and cohorts are combined, curves for the four experience groups are obtained, as shown in Figure 22. (For the period 1960–1963, an adjustment was made to compensate for the fact that only three rather than five years are involved.) The relative stability of the NN and AA groups is clearly apparent in Figure 22, in contrast to the restlessness of the NA and AN groups. In all four groups, the World War II years are marked by high mobility; the small increase in the last two periods is probably a function of the increasing proportion of younger people who have not yet settled down. This is indicated by the cohort breakouts within the always-academic group shown in Figure 23.

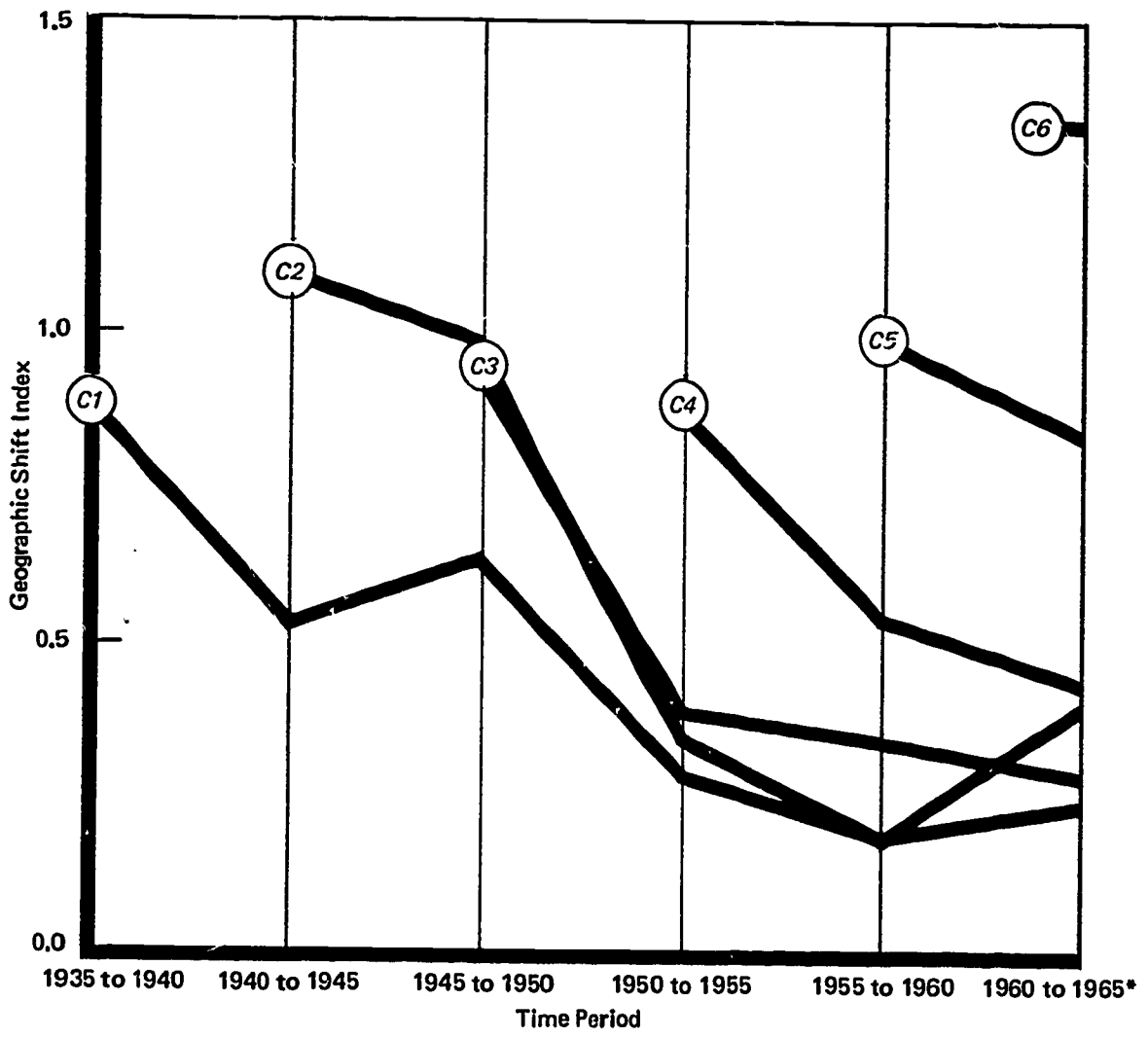
Figure 24 focuses sharply on the period of change in employer category, presenting much the same data as Figure 21, but in a form that facilitates direct comparisons of the four experience groups. In this figure, the AA and NN groups are shown with the time of graduation set equal to the time of change in employer category for the NA and AN groups. As in Figure 21, the last two periods shown are very similar for all experience groups.

FIGURE 22
Geographic Shift Index for Each Experience Group by Time Period, All Fields and Cohorts Combined



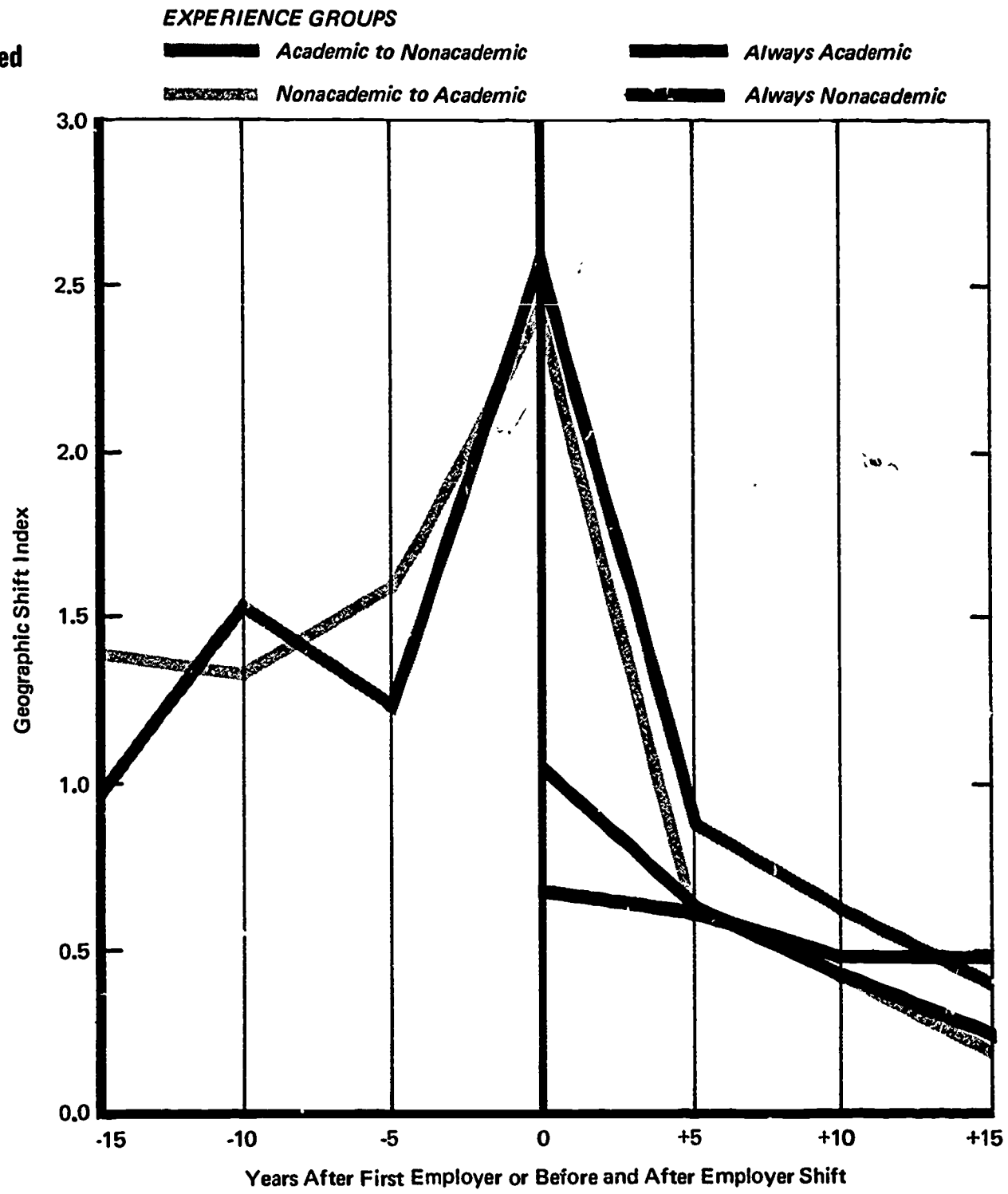
*Three-year value multiplied by 1.5 to estimate five-year value.

FIGURE 23
Geographic Shift Index for Always-Academic Group by Cohort, All Fields Combined



*Three-year value multiplied by 1.5 to estimate five-year value.

FIGURE 24
Geographic Shift Index Related to Employer Shift or First Employer, by Experience Group



The above effects combine all fields and both sexes, and most of the data also combine all cohorts. The possibility of sex differences was considered, but the number of cases was too small, especially when married and single women are considered separately, to permit reliable statistical analysis. The data were also examined by field, but no large field differences were observed for any of the experience groups. The geoshift indices were slightly lower for the humanities, arts, professions group, however, than for the others, probably because they are in general somewhat older, attaining the doctorate at a later phase of their career development than is characteristic of the science fields.

Again, Who Does Go Where?

The reasons for these migrations were not explored in this study and can only be inferred from external data. One of the questions that inevitably arises is the matter of ability levels. Are those who move to another area more capable, on the average, than those who stay in the area? Where two areas exchange personnel, are the two flows equal in quality? The present data do not answer these questions, so that we are left with only nose-counts for data. If the quality dimension could be added, it would undoubtedly make the information of far greater value for educational and manpower policy decisions.

SUMMARY OF CHAPTER III

The source of support for graduate education has, for the 10,000 PhD careers here analyzed, only a minor and uncertain relationship to later career experience. It is slightly more probable that those receiving institutional support will later be employed in academe, and that those with governmental support will later be in nonacademic positions. Other predoctoral variables are not related to subsequent career patterns. Conclusions regarding the impact of the massive postwar mission-oriented governmental programs of graduate-school support would, however, be unwarranted from these data. Differences in functional time distribution are more spectacular in those who switch to and from academe. Those who move into academe do more teaching even before switching than do their nonacademic colleagues. Those who move out of academic positions do more research before switching than is typical in academe. An increase in administrative duties typically accompanies the switch to nonacademic positions.

The reported number of hours worked per week is higher in academic than in nonacademic positions, and those who switch employment categories fairly soon adopt the hours that are typical in their new positions.

People who have never changed employer category are least likely to switch field of specialization. Those who do change employer category are more than twice as likely to have already switched specialty fields; the switch rate climbs again with the change in employment and thereafter settles down to a rate typical of those who have never changed employer category.

Geographic migration following receipt of the doctorate was primarily from the Midwest to South and West, and from New England to various other regions. Migration rates and distances were greater for those who changed employer category than for those who did not and were maximal at the time of shift in employment.

CHAPTER IV CAREERS OF WOMEN

Slightly more than one in ten of the PhD's in the present study are women. This is very close to the proportion in the current output of people with doctoral degrees. Studies* have shown that women doctorate holders have somewhat greater academic ability than their male counterparts, and it is evident that women constitute a major underutilized resource of high-level talent. Special attention was therefore given to the question of womanpower in this study of career patterns. How were women's careers different from those of men, over the time span 1935 to 1963? What were the differences between the careers of married women PhD's and their single (i.e., never-married) peers? Were there significant differences between the early and later cohorts? Were there differences from field to field? How did they compare with the total (predominantly male) group in all of these things and in such factors as frequency of job changing, geographic migration, changing of field of specialization? What about research support on the present job? Questions such as these must be answered, at least to a first approximation, if a rational basis for positive action is to be established by universities, by professional bodies, or by the federal government, with respect to women's careers in scientific or scholarly work.

THE SAMPLE

We have seen that the total group of 10,011 cases is scarcely large enough to answer all the questions one would like to ask, when it must be broken down into more than 200 groups to take account of fields, cohorts, and employer categories. The problem of numbers is more acute where women's careers are concerned, because there were only 1,045 women available for study in this sample. In the physical sciences, the proportion of women is especially low; there were only 84 women physical scientists in all cohorts combined. In the other fields the proportions are more favorable, but only in the biosciences is a really substantial number (426) available for study. It was thus necessary from the outset to combine cohorts in order to have any reliable figures. Summary Cohort 7, combining the graduates of 1935, 1940, and 1945 (563 cases in all) provides a look at the circumstances of those whose educational background was primarily pre-World War II. Summary Cohort 8, comprising the graduates of 1950, 1955, and 1960 (482 cases) affords data on the postwar generation. It might be noted at this point that the relative proportion of women in these two cohort groups varies significantly. In Cohort 7, 13.23% of the people were women; in Cohort 8 this proportion dropped to 8.37%. This is in accord not only with the wartime and postwar fluctuation but also with the general trend of doctorate production over this quarter-century; during the 1940–1944 period, 13.3% of all doctorates

*Lindsey R. Harmon, High School Ability Patterns, a Backward Look from the Doctorate, Scientific Manpower Report #6, Office of Scientific Personnel, National Research Council, August 1965.

were awarded to women, while in 1950–1954 the percentage was 9.3, and in 1960–1961 it had come back to 10.9.*

Patterns When Cases Are Few

Patterns of occupational behavior are so varied that under the best of circumstances generalizations must be limited. As the number of cases gets smaller, the problem of generalization gets larger. In the extreme, one can only cite examples. Short of that, by grouping people who have some feature of their careers in common, it is frequently possible by statistical analysis to detect some commonalities which would otherwise escape notice. These commonalities describe an average tendency, the result of "pushes" and "pulls" in different directions. One subgroup may "push" and another "pull" with respect to a particular characteristic. A small minority of the cases may thus deviate markedly from the general group average on some characteristic which nevertheless characterizes the general parent population. To choose an illustration from another sphere, consider the relationship of salary and education. Suppose one selects from the general population two samples, one with incomes over $20,000 per year and the other with incomes under $5,000 per year. A substantial proportion of the $20,000 group would have college educations, few of the $5,000 group would have completed college. Higher education, or lack of it, would thus stand out as a distinguishing group characteristic. This difference, while quite reliable, would still be limited as a generalization, for not all in the $20,000 group would be college graduates, nor would all in the $5,000 group lack this education. Similar situations occur repeatedly in examination of career patterns, except that the interpretation is seldom so simple and diagrammatic. More frequently, a complex of three or four factors is interacting simultaneously.

An example may be drawn from the reporting of income. Of the married women, 42% reported the amount of their income for the year 1955, but reporting percentages of individual cohorts vary from 34% to 75%. Many factors are interacting to produce these differences: marital status, stage of career, memory of the individual answering the questionnaire, and selective return of questionnaires are a few of the factors that have come to our attention. Had we separated the data by field and experience groups, other factors not reflected here might have come to light, but the number of individuals in each group would have been too small for production of reliable figures.

Marriage is a complicating factor, especially in the careers of women PhD's. Those who have ever been married are in the "married" category here; "single" means never married. We have not investigated the effect of marriage and dependents in the case of the men, assuming that most men marry and that the effect of marriage and family on their careers is not so important as it is with the women. The small group of women PhD's (about one woman to each nine men) must be further subdivided on the basis of marital status, as marriage and child rearing does quite evidently have an important effect on their careers. Thus the number of cases in any group becomes very small, and generalizations increasingly difficult. However, wherever possible, such generalizations as seem warranted by the data will be made, with frequent caveats where necessary because of the limited number of cases.

Field Variations

The number of married and single women, by cohort and experience group, and by field, is shown in Tables 18 and 19. Table 18 shows the number in each cohort, including the Summary Cohorts 7 and 8, by experience group and marital status. Table 19 gives the breakout by field, marital status, and experience

*See Table 26 in Lindsey R. Harmon, Doctorate Production in United States Universities 1920-1962, Publ. 1142, Nat. Acad. Sci.—Nat. Res. Council, Washington, D.C., 1963 and Chapter V in Doctorate Recipients from United States Universities 1958-1966, Publ. 1489, Nat. Acad. Sci.—Nat. Res. Council, Washington, D.C., 1967.

group for the summary cohorts and for all cohorts combined. It is apparent from these figures that the number of cases available within any cell is small, and that further analysis is quite limited. If breakouts by marital status are desired, then it is necessary to combine cohorts or fields, or even experience groups, to provide a sufficient number of cases to permit further statistically reliable analyses. Over 40% of the cases are in the biosciences. Consequently, this is usually the only field with a sufficient volume of data to make separate-field statistics reliable. It is apparent that very little breakout within the physical science group is possible, with only 84 cases in all. The social sciences and the humanities, arts, professions are in an intermediate position on the numbers scale, permitting some further breakout, but not much.

Tables 18 and 19 merit some examination, as they show important differences in work experience among the several cohorts, primarily as a result of longer exposure to the job market by the older cohorts. The academic-to-nonacademic (AN) and nonacademic-to-academic (NA) groups become proportionately larger as time passes and more opportunity is afforded for switching employer categories, the proportion rising from about one in eight in the youngest cohort to about half for the oldest. The nonacademic group varies irregularly as a proportion of the whole group of women PhD's, from one in ten at the lowest to one in five at the highest. The always-academic group holds major interest, however, as it is the largest single category, including three fourths

TABLE 18

Women in Career Patterns Sample by Cohort, Experience Group, and Marital Status

		NUMBER OF WOMEN BY EXPERIENCE GROUP				
COHORT	MARITAL STATUS	TOTAL	ALWAYS ACADEMIC	NONACADEMIC TO ACADEMIC	ALWAYS NONACADEMIC	ACADEMIC TO NONACADEMIC
7 (Cohorts 1–3)	TOTAL	563	221	134	80	
	Single	252	138	36	29	
	Married	311	83	98	51	
1	TOTAL	158	42	45	34	
	Single	75	30	15	11	
	Married	83	12	30	23	
2	TOTAL	168	67	38	24	
	Single	75	42	10	7	
	Married	93	25	28	17	
3	TOTAL	237	112	51	22	
	Single	102	66	11	11	
	Married	135	46	40	11	
8 (Cohorts 4–6)	TOTAL	482	294	60	81	
	Single	214	146	17	36	
	Married	268	148	43	45	
4	TOTAL	134	66	31	21	
	Single	59	35	9	10	
	Married	75	31	22	11	
5	TOTAL	148	80	20	31	
	Single	68	40	7	15	
	Married	80	40	13	16	
6	TOTAL	200	148	9	29	
	Single	87	71	1	11	
	Married	113	77	8	18	

TABLE 19

Women in Career Patterns Sample by Field, Experience Group, and Marital Status

COHORT	EXPERIENCE GROUP	NUMBER OF WOMEN BY FIELD AND MARITAL STATUS														
		ALL FIELDS			BIOSCIENCES			SOCIAL SCIENCES			PHYSICAL SCIENCES			HUMANITIES, ARTS, PROFESSIONS		
		SGL	MAR	TOTAL	SGL	MAR	TOTAL	SGL	MAR	TOTAL	SGL	MAR	TOTAL	SGL	MAR	TOTAL
Total of Cohorts 1-6	TOTAL	466	579	1045	187	239	426	103	171	274	29	55	84	147	114	261
	Always Academic	284	231	515	100	98	198	54	61	115	22	20	42	108	52	160
	Nonacademic to Academic	53	141	194	20	59	79	15	37	52	2	11	13	16	34	50
	Always Nonacademic	65	96	161	29	26	55	20	33	53	3	16	19	13	21	34
	Academic to Nonacademic	64	111	175	38	56	94	14	40	54	2	8	10	10	7	17
7 (Cohorts 1-3)	TOTAL	252	311	563	98	132	230	64	96	160	20	28	48	70	55	125
	Always Academic	138	83	221	53	32	85	27	23	50	15	7	22	43	21	64
	Nonacademic to Academic	36	98	134	9	45	54	13	23	36	2	9	11	12	21	33
	Always Nonacademic	29	51	80	9	17	26	11	17	28	1	7	8	8	10	18
	Academic to Nonacademic	49	79	128	27	38	65	13	33	46	2	5	7	7	3	10
8 (Cohorts 4-6)	TOTAL	214	268	482	89	107	196	39	75	114	9	27	36	77	59	136
	Always Academic	146	148	294	47	66	113	27	38	65	7	13	20	65	31	96
	Nonacademic to Academic	17	43	60	11	14	25	2	14	16	–	2	2	4	13	17
	Always Nonacademic	36	45	81	20	9	29	9	16	25	2	9	11	5	11	16
	Academic to Nonacademic	15	32	47	11	18	29	1	7	8	–	3	3	3	4	7

of the women in the youngest cohort, but decreasing regularly through the older cohorts to about one fourth in Cohort 1. The proportion of married women in the combined AN + NA group is almost twice that of single women, indicating that marriage and family may interrupt careers and require more frequent job switching. Sometimes in situations where there is only one major academic employer, nepotism rules limit the opportunities for women whose husbands are academically employed. Table 19 shows similar data by field, and here the cohorts are condensed into the prewar Cohort 7 and the postwar Cohort 8 to increase the stability of the field figures, but the numbers are still too small for highly reliable analysis.

Another way of looking at the data is furnished by Table 20, in which the total male + female career patterns sample is used as a base, and the percentage of women is computed, by field, summary cohort, and experience group. Within each experience group, the proportions of married and single women are also shown. These two sets of percentages—of women, as a percentage of the total sample, and of single women as a percentage of all women—are shown graphically in Figures 25 and 26. In the top portion of Figure 25 the field variations in percentage of women are shown, and in the bottom portion, the cohort variations. Within each of these categories, the breakout by experience group is also given. The brown box, in each figure element, indicates the field or cohort percentage of women; the colored and shaded bars show the further breakout by experience group. The very low proportion of women in the physical sciences is in striking contrast to the relatively high proportion in the humanities, arts, professions group in Figure 25. Within fields, the NA and AN experience groups tend to be highest, projecting above the box for the field as a whole. This reflects the familiar fact of greater employer-category switching among women as compared with men. Similar variations by cohort are reflected in the bottom portion of the figure. In both cohorts and in all fields except the social sciences, the always-nonacademic (NN) group is lower than the percentage of women in general, as shown by the brown boxes. Generally the NN group is the lowest of the four experience groups, leading to the generalization that, except for the social sciences, consistent nonacademic employment of PhD's is almost entirely a man's field (93%, as shown by the 7% NN bar for women in the lower left portion of Figure 25).

Figure 26 shows graphically the percentage of single women among all women by field and experience group. Single women, while a minority overall, are much more frequent in the always-academic (AA) group and much less frequent in the groups that change employer categories. This variation holds rather well across the four fields. This is quite consistent with the idea that the careers of single women tend more to resemble those of men, and that married women, with more frequent career interruptions (child rearing, husbands moving), may enter what employment is feasible at a particular place and time, without the consistent career development that is so much more important to single women.

TABLE 20

Percentage of Women in Career Patterns Sample by Cohort, Experience Group, Marital Status, and Field[a]

COHORT	EXPERIENCE GROUP		PERCENTAGE OF WOMEN BY FIELD: TOTAL ALL FIELDS	BIOSCIENCES	SOCIAL SCIENCES	PHYSICAL SCIENCES	HUMANITIES, ARTS, PROFESSIONS
TOTAL	TOTAL	Women in Total Sample	10.5	10.8	12.6	3.7	16.3
		Single Women	*45*	*44*	*38*	*35*	*56*
		Married Women	*55*	*56*	*62*	*65*	*44*
	Always Academic	Women in Total Sample	10.4	10.2	9.7	5.6	15.5
		Single Women	*55*	*51*	*47*	*52*	*67*
		Married Women	*45*	*49*	*53*	*48*	*33*
	Nonacademic to Academic	Women in Total Sample	14.8	17.0	15.4	4.3	24.6
		Single Women	*27*	*25*	*29*	*15*	*32*
		Married Women	*73*	*75*	*71*	*85*	*68*
	Always Nonacademic	Women in Total Sample	6.9	6.2	15.2	2.2	14.5
		Single Women	*40*	*53*	*38*	*16*	*38*
		Married Women	*60*	*47*	*62*	*84*	*62*
	Academic to Nonacademic	Women in Total Sample	12.1	14.2	17.8	2.9	13.2
		Single Women	*37*	*40*	*26*	*20*	*59*
		Married Women	*63*	*60*	*74*	*80*	*(41)*
7	TOTAL	Women in Total Sample	13.2	14.8	16.3	4.8	17.9
		Single Women	*45*	*43*	*40*	*42*	*56*
		Married Women	*55*	*57*	*60*	*58*	*44*
	Always Academic	Women in Total Sample	12.3	13.4	11.1	7.3	16.0
		Single Women	*62*	*62*	*54*	*68*	*67*
		Married Women	*38*	*38*	*46*	*(32)*	*33*
	Nonacademic to Academic	Women in Total Sample	17.3	20.7	17.4	6.3	25.2
		Single Women	*27*	*(17)*	*36*	*(18)*	*36*
		Married Women	*73*	*83*	*64*	*(82)*	*64*
	Always Nonacademic	Women in Total Sample	9.7	9.4	21.4	(2.4)	19.3
		Single Women	*36*	*(35)*	*39*	*(12)*	*(44)*
		Married Women	*64*	*65*	*61*	*(88)*	*56*
	Academic to Nonacademic	Women in Total Sample	14.9	16.7	23.6	(3.5)	13.3
		Single Women	*38*	*42*	*28*	*(29)*	*(70)*
		Married Women	*62*	*58*	*72*	*(71)*	*(30)*
8	TOTAL	Women in Total Sample	8.5	8.2	9.6	2.8	15.2
		Single Women	*44*	*45*	*34*	*25*	*57*
		Married Women	*56*	*55*	*66*	*75*	*43*
	Always Academic	Women in Total Sample	9.4	8.6	8.9	4.5	15.3
		Single Women	*50*	*42*	*42*	*(35)*	*68*
		Married Women	*50*	*58*	*58*	*65*	*32*
	Nonacademic to Academic	Women in Total Sample	11.2	12.2	12.2	(1.6)	23.6
		Single Women	*28*	*44*	*12*	*—*	*(24)*
		Married Women	*72*	*56*	*88*	*(100)*	*76*
	Always Nonacademic	Women in Total Sample	5.3	4.7	11.5	2.0	11.3
		Single Women	*44*	*69*	*(36)*	*(18)*	*(31)*
		Married Women	*56*	*(31)*	*64*	*(82)*	*69*
	Academic to Nonscademic	Women in Total Sample	8.1	10.8	(7.4)	(2.0)	(13.0)
		Single Women	*32*	*38*	*(12)*	*—*	*(43)*
		Married Women	*68*	*62*	*(88)*	*(100)*	*(57)*

[a]Parentheses indicate percentages based on fewer than 10 cases.

FIGURE 25
Percentage of Women in Career Patterns Sample, by Experience Group, Cohort, and Field

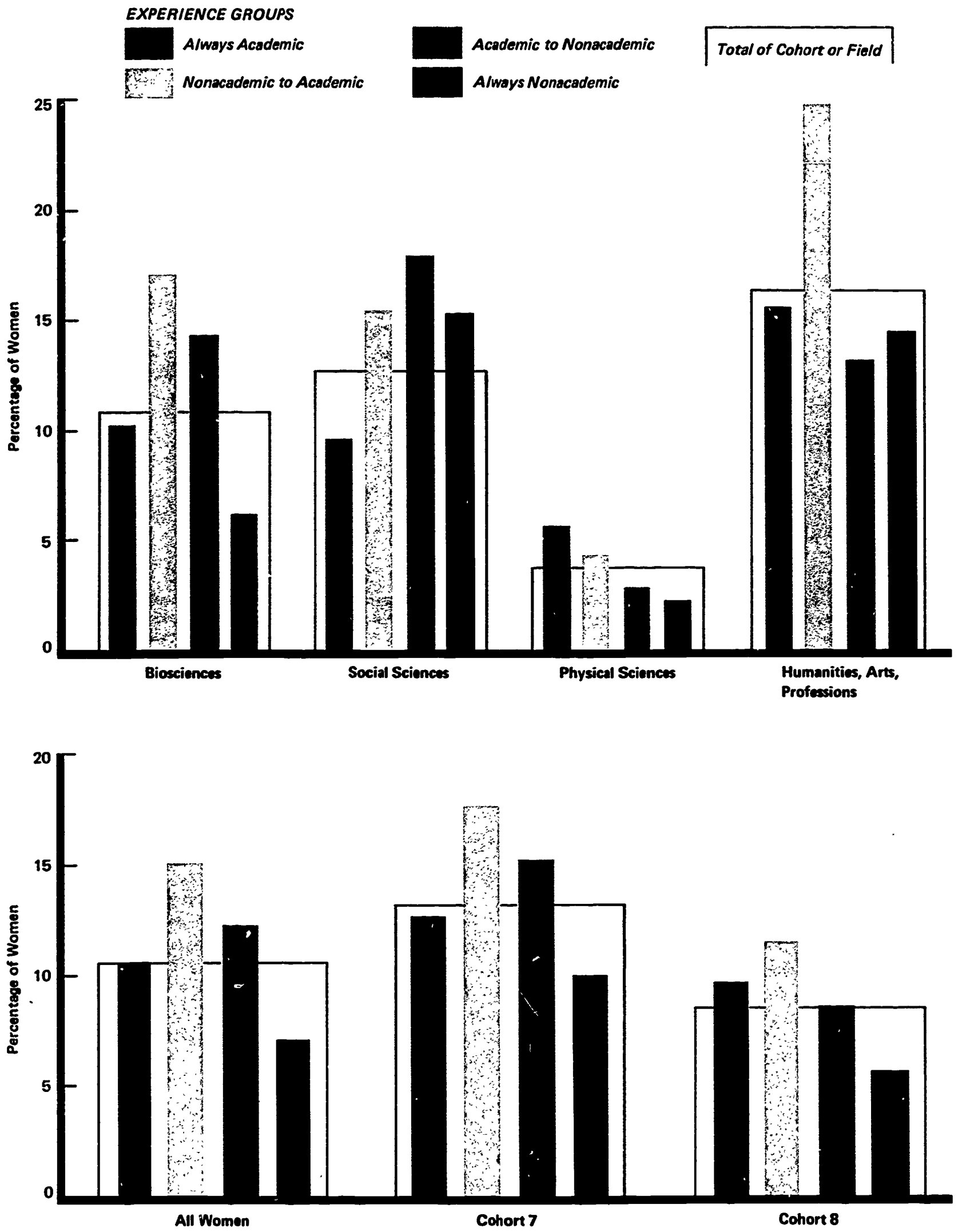
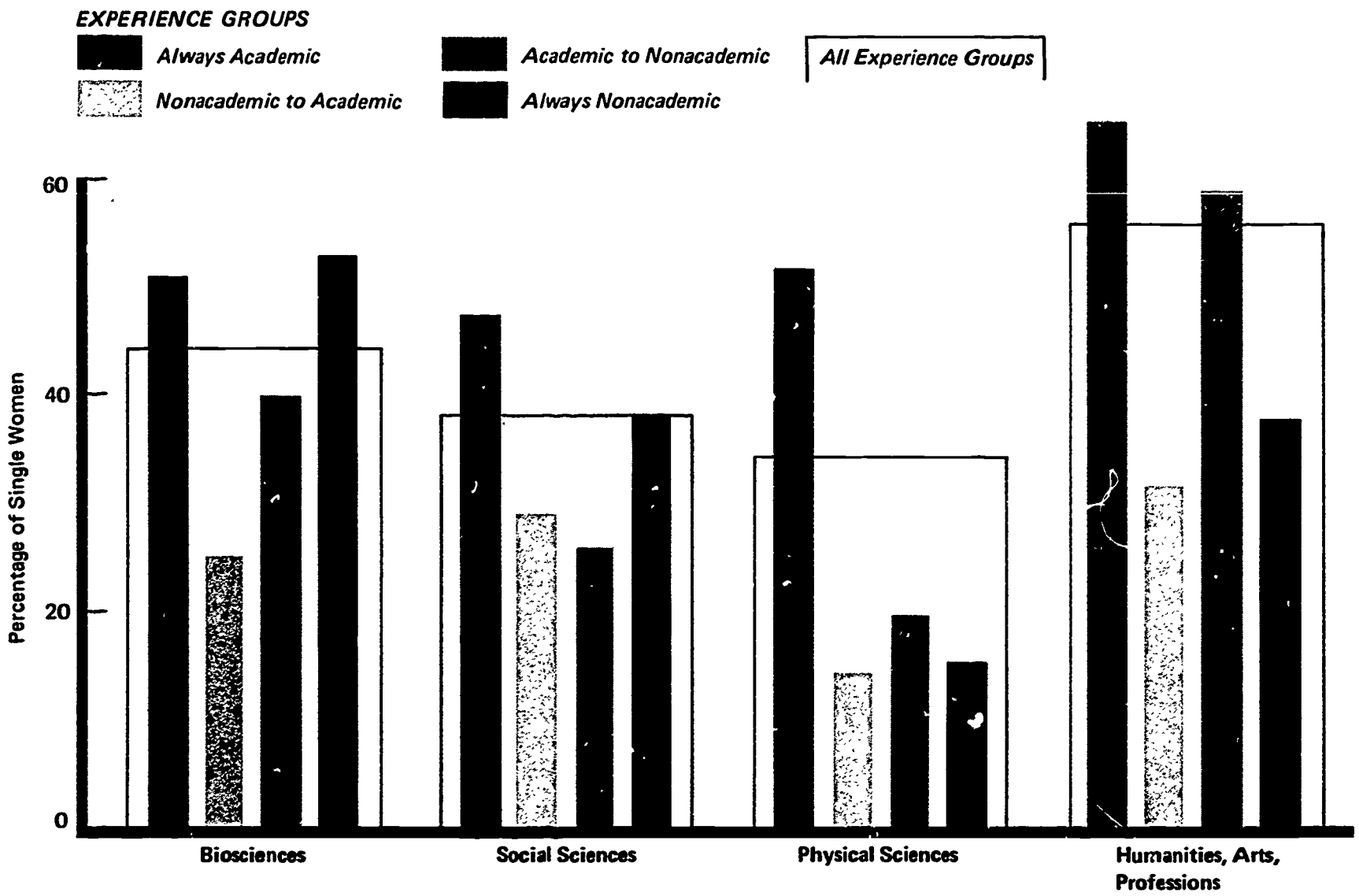


FIGURE 26
Percentage of Single Women by Field and Experience Group



GRADUATE SCHOOL SUPPORT FOR WOMEN

The 1965 report, Profiles of Ph.D's in the Sciences, provided detailed tables on sources of support for graduate education, by cohort and field. Chapter III of the present report analyzes the relation of major support sources to later career patterns, for men and women combined. This section uses those data as reference points in describing support for women alone. However, because of the smaller numbers of women, fields are not considered separately. Married and single women are studied separately, however, because of the obvious possibility of significant differences. The relevant data are given below and in Table 21. The brief table below indicates the percentage of support from each of three sources, by marital status, for the always-academic (AA) and always-nonacademic (NN) women in postwar Cohort 8.

	All Women		Single Women		Married Women	
Source of Support	AA (%)	NN (%)	AA (%)	NN (%)	AA (%)	NN (%)
Government	13	11	12	15	14	8
Institutions	37	32	35	27	40	36
Own Resources	50	57	53	58	46	56

TABLE 21

Number of Women by Source and Amount of Support in Graduate School by Experience Group and Marital Status, Cohort 8

EXPERIENCE GROUP	MARITAL STATUS	TOTAL NUMBER REPORTING SUPPORT	NUMBER OF WOMEN BY SOURCE AND AMOUNT OF GRADUATE SCHOOL SUPPORT									SOURCE OF SUPPORT UNKNOWN
			GOVERNMENT			INSTITUTIONS			OWN			
			NONE	SOME	MAJOR	NONE	SOME	MAJOR	NONE	SOME	MAJOR	
TOTAL	**TOTAL**	**467**	**356**	**69**	**42**	**146**	**197**	**124**	**79**	**203**	**185**	**15**
	Single	**207**	162	25	20	79	74	54	27	91	89	7
	Married	**260**	194	44	22	67	123	70	52	112	96	8
Always Academic	**TOTAL**	**286**	**217**	**40**	**29**	**90**	**120**	**76**	**51**	**123**	**112**	**8**
	Single	**140**	112	15	13	53	49	38	16	64	60	6
	Married	**146**	105	25	16	37	71	38	35	59	52	2
Nonacademic to Academic	**TOTAL**	**58**	**49**	**5**	**4**	**14**	**25**	**19**	**7**	**29**	**22**	**2**
	Single	**17**	12	3	2	4	8	5	3	9	5	—
	Married	**41**	37	2	2	10	17	14	4	20	17	2
Always Nonacademic	**TOTAL**	**77**	**57**	**16**	**4**	**30**	**30**	**17**	**10**	**30**	**37**	**4**
	Single	**36**	27	5	4	17	10	9	4	15	17	—
	Married	**41**	30	11	—	13	20	8	6	15	20	4
Academic to Nonacademic	**TOTAL**	**46**	**33**	**8**	**5**	**12**	**22**	**12**	**11**	**21**	**14**	**1**
	Single	**14**	11	2	1	5	7	2	4	3	7	1
	Married	**32**	22	6	4	7	15	10	7	18	7	—

These data are expressed graphically in Figure 27, along with the data for the total male + female career patterns sample for comparison. As with the men, the institutional support is greater for the AA group. Governmental support is generally much less for the women than for the men, and the individual's own sources are relied upon much more. Married women received more institutional support, but the single women in the NN group had more governmental support. The numbers are small, however, and the differences are not highly reliable.

A somewhat different way of viewing the data is given in Table 21, and translated into graphic form in Figure 28, which is analogous to Figure 15 in Chapter III. As an over-all interpretation, it is fair to say that no significant relationship is found between the source of graduate support and subsequent career experience for the single and married women combined. This is a very reasonable finding, considering the complicating factors in women's careers and the fact that even in the predominantly male total group there was only a weak relationship between such support and later careers.

FIGURE 27
Sources of Support in Graduate School for Always-Academic and Always-Nonacademic Women, by Marital Status, and Total Career Patterns Sample, Cohort 8, All Fields Combined.

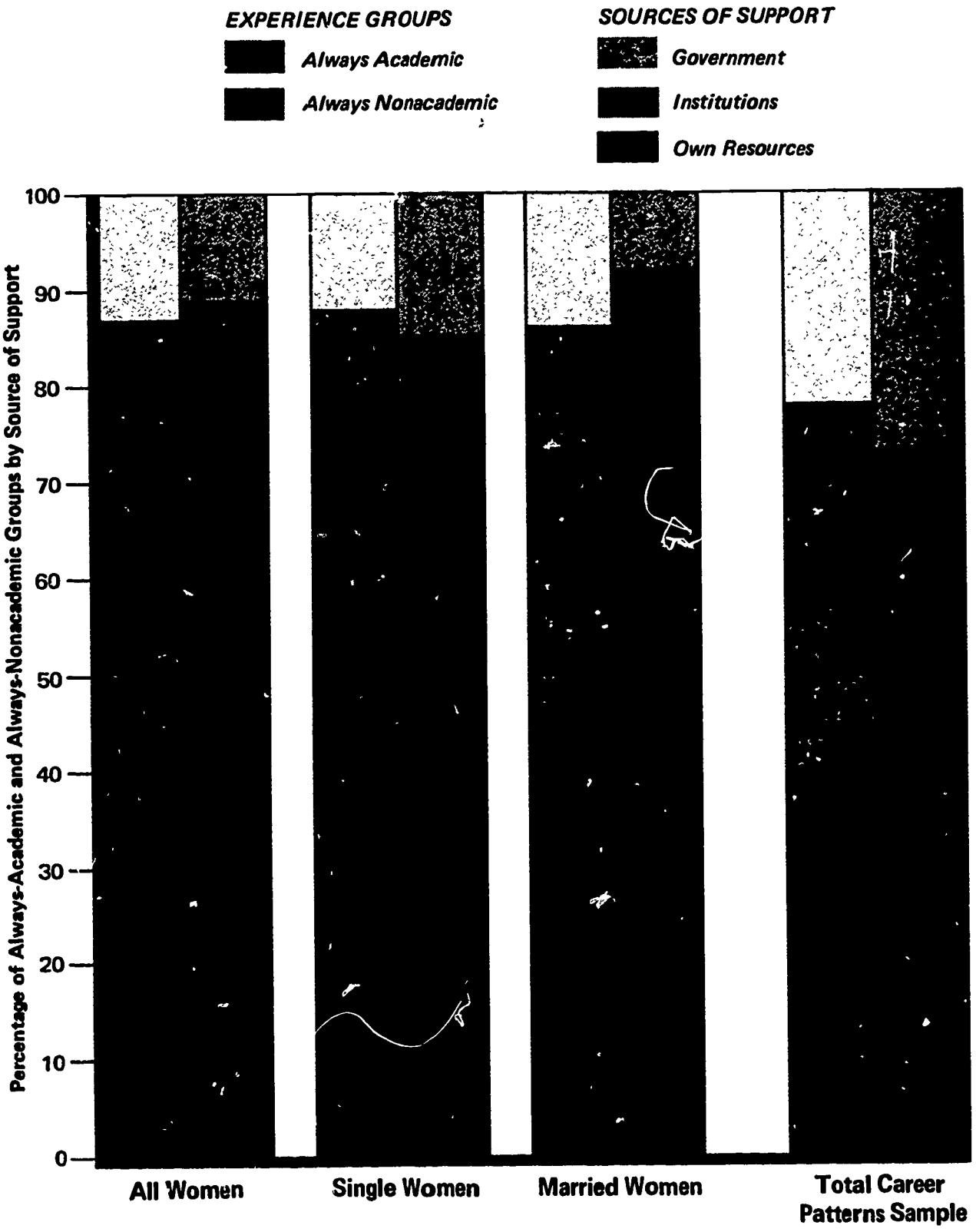
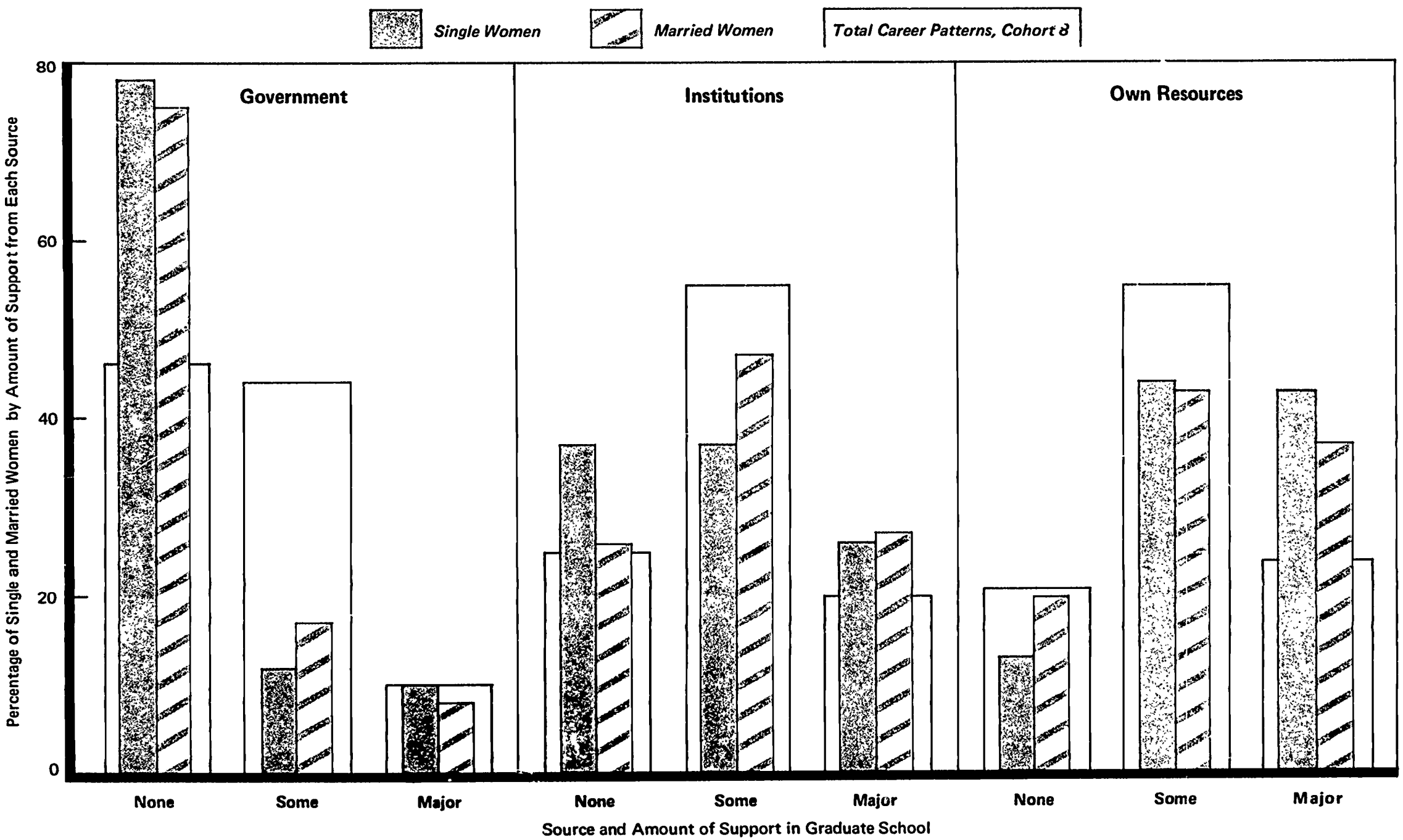


FIGURE 28
Percentage of Single and Married Women by Sources and Amounts of Support in Graduate School, Cohort 8



The support for women, as compared with that for men, is of interest in itself, however. This comparison is provided by the data of Cohort 8, in Figure 28. As in Chapter III, governmental, institutional, and own support is shown in three categories: none; some (one tenth to six tenths); and major (seven tenths to total). The boxes represent the total (predominantly male) group, the solid colored bars are for single women, the diagonally striped bars are for married women.

The most striking feature of Figure 28 is the high proportion of women receiving no governmental support. The proportion receiving major governmental support is about the same as for men; three times as large a proportion of men receive some government support. In the institutional support category, fewer women receive an intermediate level of support; more receive major support or no support, as compared with men. A necessary corollary is that more women, proportionately, receive major support from their own and family sources. In brief, women have less diverse sources of support and tend to be more dependent than men on one major source, whether that source is government, institution, or self.

The differences in support patterns between married and single women are not great; most of the differences can be accounted for as random-sampling fluctuations. It is a bit surprising, however, that own support—which includes husbands—is less for married than for single women. Both governmental and institutional support are slightly greater for the married than for the single women. This slight but consistent difference may be a function of greater ability to win competitive fellowships; this would be consistent with the finding reported elsewhere* that those women who were married at the time of receiving the PhD degree are more capable academically than their unmarried contemporaries.

WOMEN WITH POSTDOCTORAL FELLOWSHIPS

Postdoctoral fellowships are not a new phenomenon, but they have increased remarkably in recent years. Over the period covered by this report, the number of fellowships awarded for postdoctoral study has climbed in the science fields, and particularly in the biosciences, as shown in Profiles of Ph.D's in the Sciences. The numbers of postdoctoral fellowship awards to PhD's in the humanities, arts, professions group, on the contrary, declined for the 1955 and 1960 cohorts even below the prewar level. It is against this general background that postdoctoral fellowships held by women may best be considered.

The numbers of postdoctoral fellowships and the percentage of each group that held fellowships are shown in Table 22. The data are reported by field and by Summary Cohorts 7 and 8. The top portion of the table presents data for all women and for married and single women separately. For reference purposes, the numbers and percentages of awards to the total career patterns sample, which is predominantly male, are given in the bottom portion of Table 22.

The total of all fields and cohorts, for married and single women combined, is 186 postdoctoral fellowships, as shown in the upper left corner of Table 22. This is 18% of the total number of women in the study. As the table shows, there were 87 awards to single women (19% of all single women) and 99 awards to married women (17% of the married group). Reading down the same column, one sees that in Cohort 7 (graduates of 1935 through 1945) 21% of the single women and 14% of the married women received postdoctoral awards, whereas in Cohort 8 (1950–1960) the percentages were practically reversed, 17% of the single women and 21% of the married women receiving awards. The most interesting feature, however, is that furnished by contrast with the male PhD's. Over-all, only 16% of them received postdoctoral fellow-

*Lindsey R. Harmon, High School Ability Patterns, a Backward Look from the Doctorate, Scientific Manpower Report #6, Office of Scientific Personnel, National Research Council, 1965.

TABLE 22

Number and Percentage of Women PhD's Holding Postdoctoral Fellowships, by Field, Cohort, and Marital Status

				PHD'S BY FIELD							
		TOTAL ALL FIELDS		BIOSCIENCES		SOCIAL SCIENCES		PHYSICAL SCIENCES		HUMANITIES, ARTS, PROFESSIONS	
COHORT		N	%	N	%	N	%	N	%	N	%
TOTAL	TOTAL WOMEN	186	18	103	24	45	16	16	19	22	8
	Single	87	19	50	27	16	16	6	21	15	10
	Married	99	17	53	22	29	17	10	18	7	6
7	TOTAL WOMEN	94	17	45	20	27	17	7	15	15	12
	Single	51	21	23	24	13	20	5	25	10	14
	Married	43	14	22	17	14	15	2	7	5	9
8	TOTAL WOMEN	92	19	58	30	18	16	9	25	7	5
	Single	36	17	27	30	3	8	1	11	5	6
	Married	56	21	31	29	15	20	8	30	2	3
Total Career Patterns Sample		1,440	16	676	19	307	16	284	13	170	13
	Cohort 7	546	15	212	16	123	15	126	13	85	15
	Cohort 8	894	17	464	21	184	18	161	13	85	11

ships, as compared with 18% of the women. The discrepancy is particularly noticeable in the natural sciences: in the bioscience field 24% of the women and 19% of the men held postdoctoral awards; in the physical sciences the percentages were 19% and 13%, respectively. There was no sex difference in the social sciences, one in six of both men and women receiving awards. In the humanities, arts, professions fields, the award ratio favored the men, 13% of whom got awards, as compared with 8% of the women.

The field distribution of postdoctoral fellowships changed markedly from the early to the later cohort. This change is displayed graphically in Figure 29, which shows the percentage of women in each field, in each cohort, who attained fellowships following the doctorate, compared with the total career patterns sample.

Whereas in the prewar cohort there was only a modest difference between the fields in percentage of postdoctoral awards, in the postwar cohort the difference becomes tremendous, being six times as high in the biosciences as in the humanities, arts, professions group. In the case of the male PhD's, as can be seen in the bottom portion of Table 22, there was almost no field difference in the prewar cohort but a 2-to-1 variation in the postwar cohort. The biggest change, for both sexes, is in the bioscience field. As was shown in the earlier publication, Profiles of Ph.D's in the Sciences, this great increase in the bioscience field is largely due to the greatly increased support furnished by the Public Health Service (NIH).

In the present report, particular interest focuses on the relationship of postdoctoral fellowships to the choice of academic or nonacademic careers. For this breakout, married and single women were combined, and the only field large enough for separate treatment was the bioscience field. The essential statistics are given in Table 23 by cohort and employment category of first postdoctoral job. The total number of women, the number of women awarded postdoctoral fellowships, and the percentage of awardees are reported within each category.

FIGURE 29
Percentage of Women Who Received Postdoctoral Fellowships, by Field and Cohort

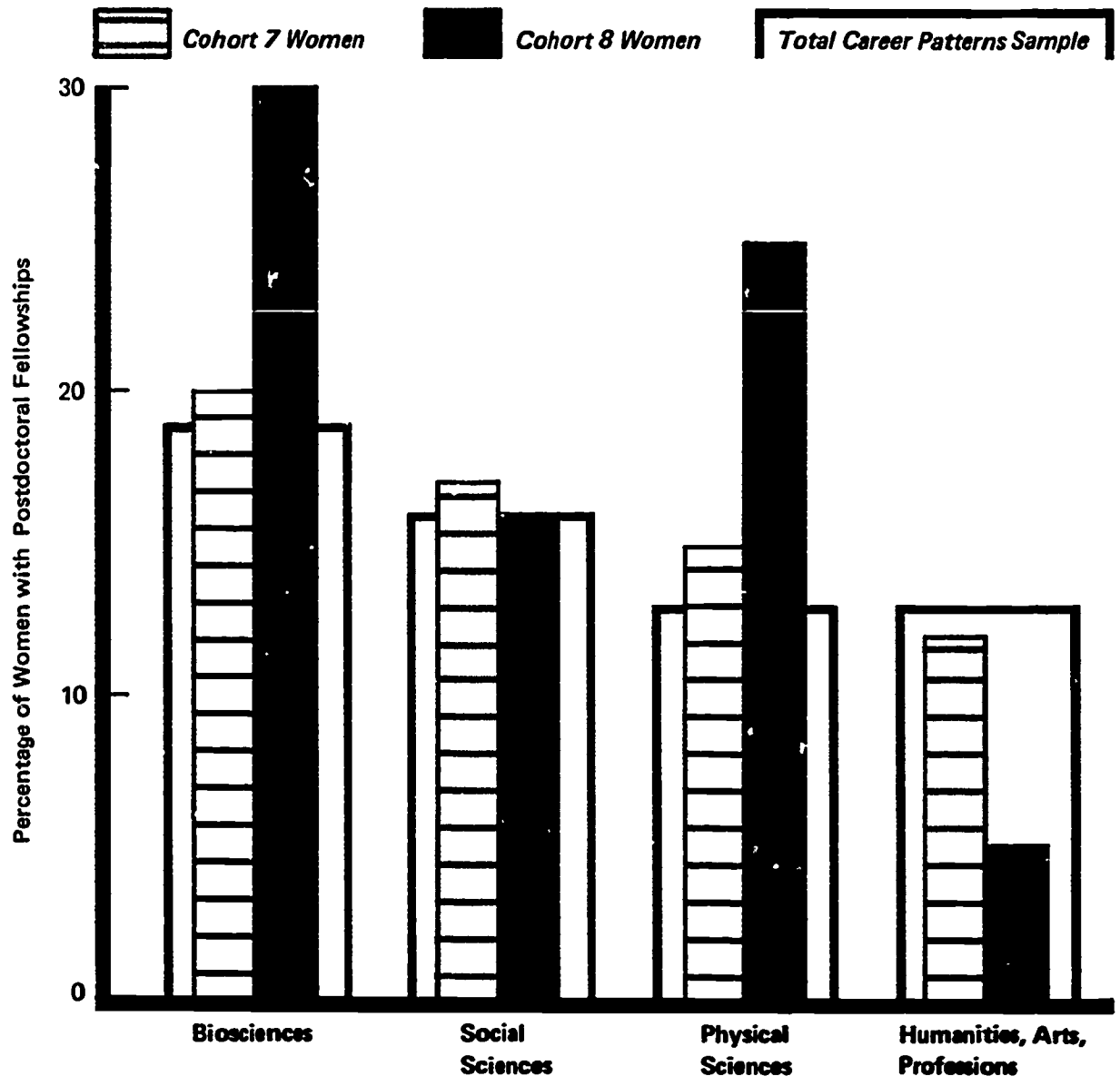


TABLE 23

Postdoctoral Fellowships Awarded to Women, by First Employment Experience Group (Academic or Nonacademic), by Cohort

		FIRST POSTDOCTORAL EMPLOYMENT					
		ACADEMIC			NONACADEMIC		
			FELLOWSHIP AWARDS			FELLOWSHIP AWARDS	
COHORT	FIELD	TOTAL WOMEN	NUMBER	%	TOTAL WOMEN	NUMBER	%
TOTAL	TOTAL	690	146	21	355	40	11
7	Biosciences	150	34	23	80	11	14
	Other Fields	199	39	20	134	10	7
8	Biosciences	142	47	33	54	11	20
	Other Fields	199	26	13	87	8	9

A consistently higher percentage of the academic group held postdoctoral awards. In both cohorts combined, 21% of the academic group held postdoctoral awards, as compared with only 11% of the nonacademic group. This difference is consistent through both cohorts, in the biosciences, and in the combination of all other fields. Whether more women with intentions of going into academic work were awarded such fellowships because of this intention, or whether the academic appointments came because of the fellowships, cannot be determined from the data. Very possibly both factors are involved, and the effects are mutually reinforcing.

RESEARCH SUPPORT ON PRESENT JOB

About 40% of women doctorate-holders reported research support on their present jobs. This percentage varied greatly from field to field, being 60% in the biosciences, 37% in the social sciences, 35% in the physical sciences, and only 23% in the humanities, arts, professions group. The separate fields do not have a volume of data adequate for analysis by experience group, cohort, and marital status; what follows therefore combines all fields. Although no tabulation of these data is reported, the highlights of the analysis are presented as follows: In the prewar Cohort 7 (1935–1945), about two thirds of the single women and one third of the married women reported research support. In the postwar Cohort 8 (1950–1960), five sixths of the single women and two thirds of the married women have research support on their present jobs. In both cohorts, about 60% of the single women who did have support depended on one source alone. Among the married women, a single source of support was characteristic of about 80% of those who had any research support at all. For all cohorts, in the nonacademic group the married women seldom had more than a single source of support; of the single women a few more had secondary sources of support. It was generally true through all cohorts and experience groups that single women had multiple sources of support more frequently than married women.

In both the prewar and postwar cohorts, the Public Health Service (NIH) was the single largest source of research support for both married and single women. In the prewar cohorts the percentage (among those who had any research support) drawing funds from PHS was 39% for the single women and 44% for the married. Among postwar graduates these percentages went up to 50% and 61%, respectively. For graduates of both periods, the National Science Foundation supported from 5% to 8% of both groups, and all other government agencies combined supported from 9% to 15% of the four groups (married and single, prewar and postwar cohorts). Other support declined from one cohort to the next, state and local government support declining from 10% down to 4% for both single and married groups. Support from one's own company declined from 8% for both groups to 5% for the single and 3% for the married women. University and nonprofit agency support was second largest in the earlier era, supporting 21% of the single women and 15% of the married; in the later period, these percentages declined to 9% and 10%, respectively. The combined data for both cohorts are presented in Figure 30, as compared with comparable data for the total sample, which is predominantly male.

WOMEN AND THE ACADEMIC LADDER

The largest single employment category for women PhD's, as for men, is the always-academic group, where the stages from instructor to full professor serve to measure the progress of careers. The data on percentage at each academic rank, by field and marital status, are reported in Table 24; Cohort 7 is at the left, Cohort 8 at the right. The top section of the table gives data for all fields combined; other sections give data for the biosciences, the social sciences, and the humanities, arts, professions group. The physical sciences have been omitted, as the data were too sparse to justify analysis. For the same reason, data are

FIGURE 30
Major Sources of Research Support on 1963 Job for Women and Total Career Patterns Sample, All Fields and Cohorts Combined

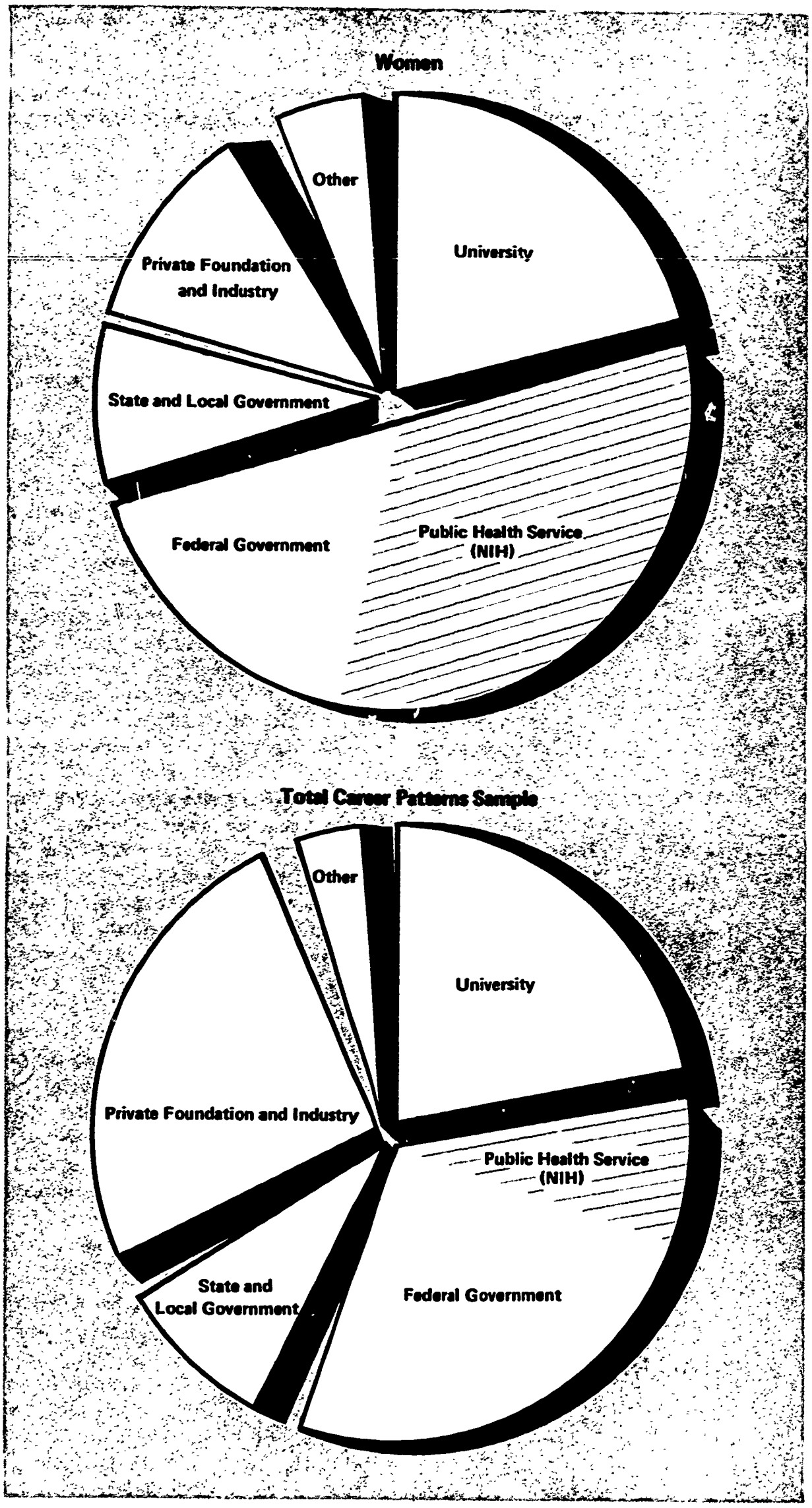
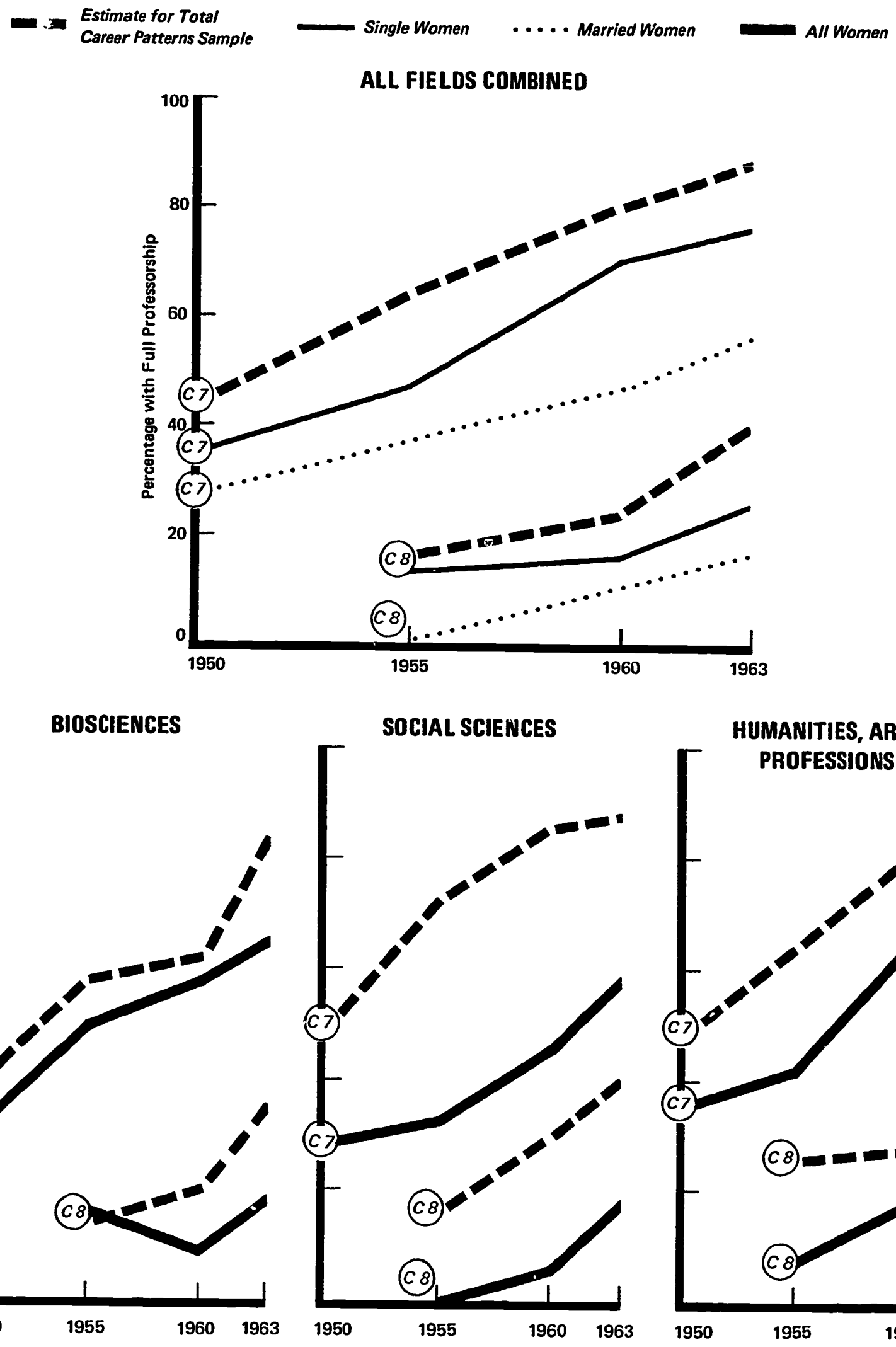


TABLE 24

Percentage of Women in Always-Academic Group by Academic Rank, Field, Marital Status, Cohort, and Year

FIELD	MARITAL STATUS	ACADEMIC RANK	PERCENTAGE OF WOMEN IN ACADEMIC RANK BY YEAR: COHORT 7 1940	1945	1950	1955	1960	1963	COHORT 8 1955	1960	1963
ALL FIELDS COMBINED	TOTAL	Prof	17	20	32	42	61	69	6	14	22
		Assoc	6	13	23	38	27	25	19	32	44
		Asst	25	33	30	16	9	5	56	29	26
		Instr	52	34	15	4	3	1	19	25	8
	Single	Prof	15	19	36	47	70	76	13	16	25
		Assoc	8	17	30	42	24	22	27	32	50
		Asst	27	35	27	9	6	2	47	32	21
		Instr	50	29	7	2	—	—	13	20	4
	Married	Prof	14	21	27	35	46	56	—	10	16
		Assoc	2	9	11	30	34	31	6	32	36
		Asst	23	29	34	29	12	8	75	23	33
		Instr	61	41	28	6	8	5	19	35	15
BIOSCIENCES	TOTAL	Prof	22	20	31	50	58	65	16	9	18
		Assoc	—	15	31	27	27	28	37	24	25
		Asst	22	32	26	20	11	6	26	28	31
		Instr	56	33	12	3	4	1	21	39	26
	Single	Prof	14	11	28	46	58	63	24	15	32
		Assoc	—	22	38	33	31	33	49	36	25
		Asst	23	35	22	19	11	4	10	17	27
		Instr	63	32	12	2	—	—	17	32	16
	Married	Prof	35	31	34	56	54	66	—	—	17
		Assoc	—	4	17	13	18	20	10	6	22
		Asst	23	31	37	23	12	12	60	45	28
		Instr	42	34	12	8	16	2	30	49	33
SOCIAL SCIENCES	TOTAL	Prof	12	12	28	33	45	58	—	6	17
		Assoc	4	18	28	42	39	34	8	25	36
		Asst	25	52	39	24	16	8	69	32	40
		Instr	59	18	5	1	—	—	23	37	7
	Single	Prof	—	2	34	36	53	54	—	14	27
		Assoc	8	35	36	49	34	34	—	10	27
		Asst	34	49	30	15	13	12	67	33	44
		Instr	58	14	—	—	—	—	33	43	2
	Married	Prof	9	22	23	30	41	67	—	2	7
		Assoc	—	—	23	40	48	30	6	34	45
		Asst	18	52	43	26	11	3	75	31	37
		Instr	73	25	11	4	—	—	19	33	11
HUMANITIES, ARTS, PROFESSIONS	TOTAL	Prof	17	24	36	42	65	75	7	18	24
		Assoc	6	12	19	39	25	21	20	34	50
		Asst	28	28	28	15	6	2	60	27	21
		Instr	49	36	17	4	4	2	13	21	5
	Single	Prof	19	26	41	50	76	85	13	17	23
		Assoc	9	12	27	43	20	15	27	33	56
		Asst	28	32	25	5	4	—	47	35	18
		Instr	44	30	7	2	—	—	13	15	3
	Married	Prof	11	20	27	29	45	52	7	17	26
		Assoc	—	12	5	32	34	35	7	36	34
		Asst	28	22	34	32	12	7	79	11	29
		Instr	61	46	34	7	9	6	7	36	11

FIGURE 31
Percentage of Women in Always-Academic Group with Full Professorship, by Field and Cohort



omitted from Cohort 7 for 1935 and from Cohort 8 for 1950. The actual numbers of women in the always-academic group for Cohorts 7 and 8 have been reported in Table 18 and, therefore, are not repeated here.

The rates at which these various groups attained the rank of full professor are shown in Figure 31, as the percentage of the group holding the rank of full professor at intervals from 1950 to 1963. The upper diagram shows the total of all fields and gives data for single and married women separately. The other three diagrams show the separate fields, omitting the breakout by marital status. In order to compare women with men, values have been estimated for comparable cohorts presented in Table 4, page 20. In general, the rate at which women achieve the status of full professor is slower than for men, the average lag varying from two to five years in the biosciences and up to as much as a decade in the social sciences. There is a marital status difference also. Considering data on women for all fields combined, the single women lead the married ones by five to ten years. At any given time, 10% to 20% more of the single than married women have achieved full professor status. The number of full professorships in Cohort 8 prior to 1955 is too small to yield a reliable percentage and has been omitted from the graphs and from Table 24.

At the other end of the academic ladder, one notes in Figure 32 that married women progress out of the instructor rank more slowly than do single women. Data for 1935 were not available, so the first stage for a portion of Cohort 7 is not shown. The comparison of curves for single and married women indicates that about two to three times as many married women as single may remain instructors several years after receipt of the PhD degree.

FIGURE 32
Percentage of Women with Instructorship in Always-Academic Group, by Marital Status and Cohort

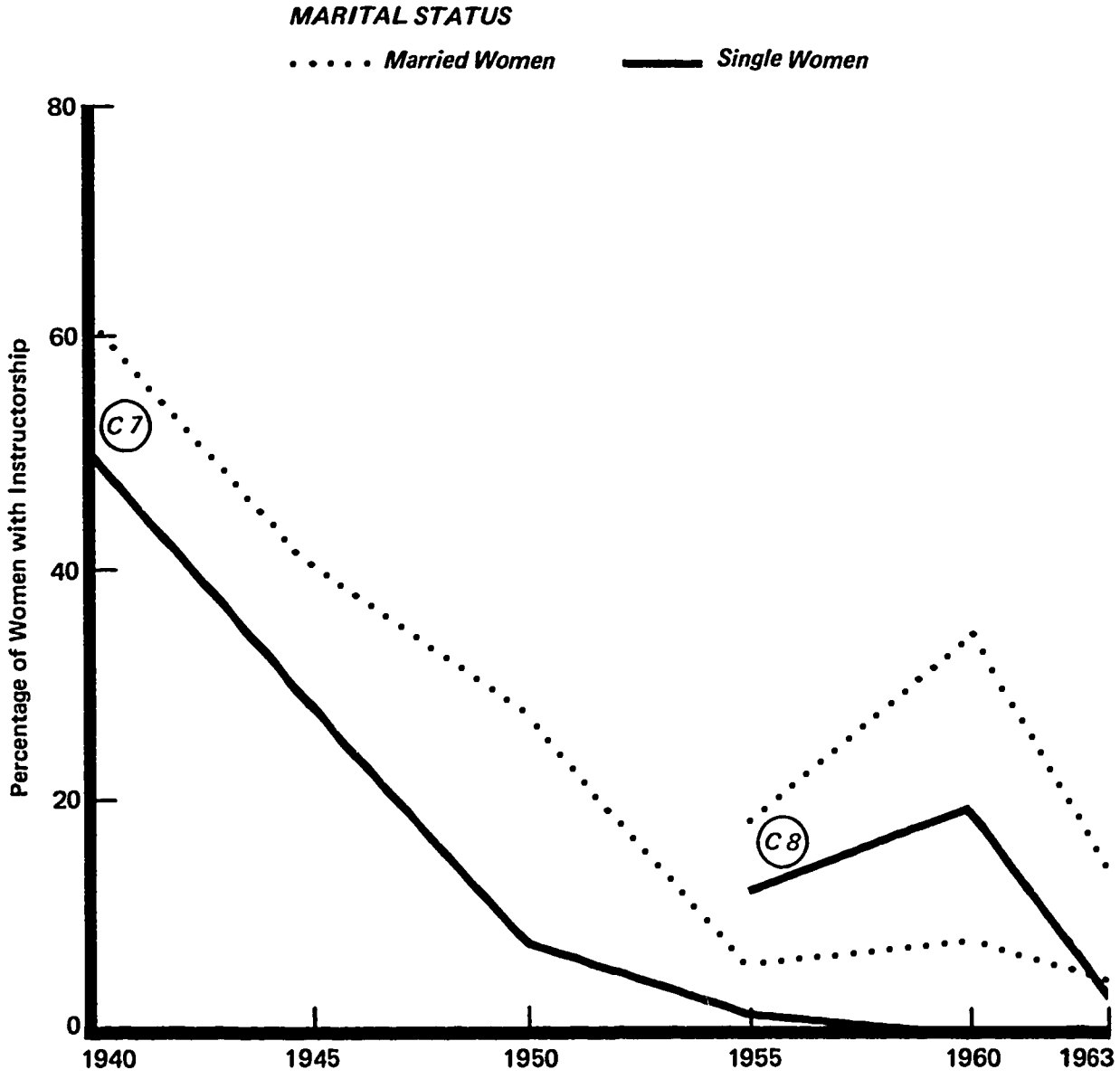


TABLE 25

Functional Time Distribution of Women in Always-Academic or Always-Nonacademic Groups, by Field, Cohort, and Time Period[a]

FIELD	NUMBER OF WOMEN IN COHORT		TIME SPENT IN EACH FUNCTION BY COHORT											
			COHORT 7								COHORT 8			
			AVERAGE FOR 1940–1945 TIME PERIOD				AVERAGE FOR 1950–1963 TIME PERIOD				AVERAGE FOR 1960–1963 TIME PERIOD			
	7	8	TCH. (%)	RES. (%)	ADM. (%)	OTH. (%)	TCH. (%)	RES. (%)	ADM. (%)	OTH. (%)	TCH. (%)	RES. (%)	ADM. (%)	OTH. (%)
ALWAYS ACADEMIC														
ALL FIELDS	**221**	**294**	**75**	**10**	**8**	**8**	**63**	**12**	**16**	**9**	**61**	**22**	**10**	**7**
Biosciences	**85**	**113**	61	28	6	6	53	28	10	10	34	57	6	3
Social Sciences	**50**	**65**	73	13	10	4	64	13	14	9	62	24	5	9
Physical Sciences	**22**	**20**	83	7	3	6	70	11	9	11	76	19	3	2
Humanities, Arts, Professions	**64**	**96**	78	5	9	7	65	8	18	9	68	12	14	7
ALWAYS NONACADEMIC														
ALL FIELDS	**80**	**81**	**27**	**20**	**22**	**31**	**25**	**22**	**28**	**25**	**11**	**37**	**29**	**23**
Biosciences	**26**	**29**	12	45	15	28	10	48	18	26	1	75	15	9
Social Sciences	**28**	**25**	32	13	15	40	32	14	30	24	10	34	12	43
Physical Sciences	**8**	**11**	(Percentages are unreliable because of small sample size)											
Humanities, Arts, Professions	**18**	**16**	36	3	37	24	34	5	36	25	21	1	60	18

[a]Sum of percentages for a given group may not equal 100 because of rounding.

The data on progress in academic rank are consistent with other information, indicating that the careers of single women more closely resemble those of men. They have the advantage over their married sisters of more consistent employment and of geographic moves related more closely to their own needs and potentialities, rather than subordinated to those of husbands. This results in steadier progress and higher rates of advancement, both out of the lowest rung of the academic ladder and on up to the top, as shown in Figures 31 and 32.

FUNCTIONAL TIME DISTRIBUTION FOR WOMEN

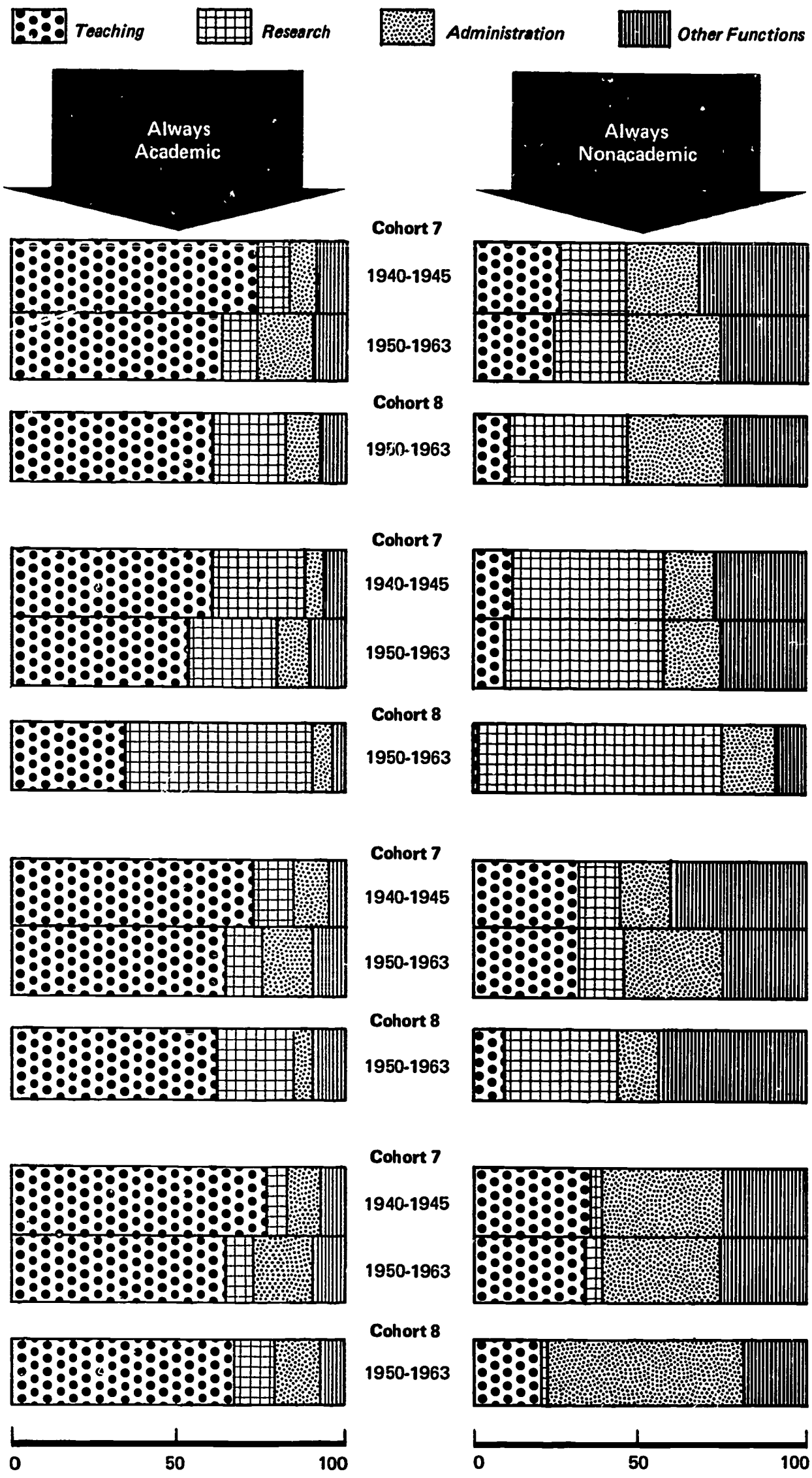
The proportion of time spent by women PhD's in teaching, research, administration, and other functions has been examined by field, by experience group, by marital status, and time period. It was found that there were no consistent differences between the married and single women in this respect; these data are therefore omitted here. The employment shift groups proved to be too small to justify analysis. The physical sciences field proved to be too small to yield stable statistics, and is shown only for the always-academic group in Table 25. Data for the 1940–1945 period are of course available only for Cohort 7. The data that were sufficiently stable to justify analysis are shown in Table 25 by cohort, time period, and field. In this table, the time periods for the job functions of Cohorts 7 and 8 are represented by an average of data from two or more of the five-year career intervals. The same data are shown graphically in Figure 33, except that the physical sciences field is omitted.

In Figure 33, there are two time periods for Cohort 7, and only one for Cohort 8. The first period for Cohort 7 includes 1940 and 1945, essentially the prewar and World War II era. The second period includes the data from 1950 through 1963, inclusive. For Cohort 8, only this latter period is available. In Figure 33, the always-academic group is shown on the left half of the page, the always-nonacademic group on the right. One set of figures is given for each of the three fields in which there were enough women to justify analysis: biosciences, social sciences, and the humanities, arts, professions group. Physical sciences are omitted, as there were too few cases.

The difference between the academic and nonacademic groups in amount of time spent in teaching is of course expected. The surprising thing is that it is not greater, as over a quarter of the time of the nonacademic women PhD's of Cohort 7 is spent in teaching in both the social sciences and the humanities, arts, professions groups. In Cohort 8, the time devoted to teaching is greatly reduced in the biosciences field in academic work and in all fields in the nonacademic category. In academe, there are small increases over time in administration and other functions, accompanied by a reduction in teaching time. In the nonacademic group, changes over time are negligible.

There are some significant cohort differences. The Cohort 8 women in academic jobs do more research, at the same career stage, than do their older sisters, in all fields. Those in nonacademic positions in Cohort 8 in the sciences do much more research, and much less teaching, than did Cohort 7. In the humanities, arts, professions field, research is practically unknown; Cohort 8 did more administration and less teaching than did Cohort 7. Field differences for comparable time periods and cohorts are, in academe, a matter principally of time for research, which is maximal in the biosciences and minimal in the humanities, arts, professions group. In nonacademic jobs, teaching is minimal in the biosciences. The catchall "other" category is large in all fields. Administration increases with time in all fields, but in the humanities, arts, professions field it is the main function, accounting for more than half the time of Cohort 8 women right from the start.

FIGURE 33
Employment Function of Women in Always-Academic or Always-Nonacademic Groups, by Cohort and Field



Forty Hours

For women, the variations in hours worked per week are not spectacular, and the 40-hour week is very much the rule. Single women average two to three hours more per week than do married women. For all women combined, the mean number of hours worked per week falls between 40 and 44 when computed for cohorts, experience groups, fields of specialization, or five-year time intervals. While hours worked per week do not indicate any significant differences between groups, these weekly averages offer assurance that there are very few women reporting part-time work. Therefore, salary, time distribution, and other job-related variables for women may be assumed to be based essentially on a standard work week. In this respect, the data may therefore by assumed to be comparable with data for the entire, predominantly male, sample.

SALARIES OF WOMEN

There are three facets of salary information which are of interest—the percentage who report salary at any given career point, the actual salary reported (geometric mean), and salary increments.

For the sample as a whole, with men and women of all cohorts combined, about two thirds reported salary for the years from 1940 to 1960. There was a slight drop in 1945, when, perhaps, some were still in the military service, and their salaries bore no relation to their professional work. In 1963, the reporting rate increased dramatically to 87%. For the entire sample, there was little variation by cohort groups. The situation is vastly different for reporting of women's salaries, however, both as to the total number reporting, and as to cohort groups, especially when the women are separated into the married and single groups. Figure 34 provides the essential data, first for the entire female sample comparing married and single women and then for the married and single women separately by cohort groups. In general, the salary-reporting rate of single women is about 10% to 15% below that of the entire sample; married women report income even less frequently. These are averages for all cohort groups, as shown in the top section of Figure 34.

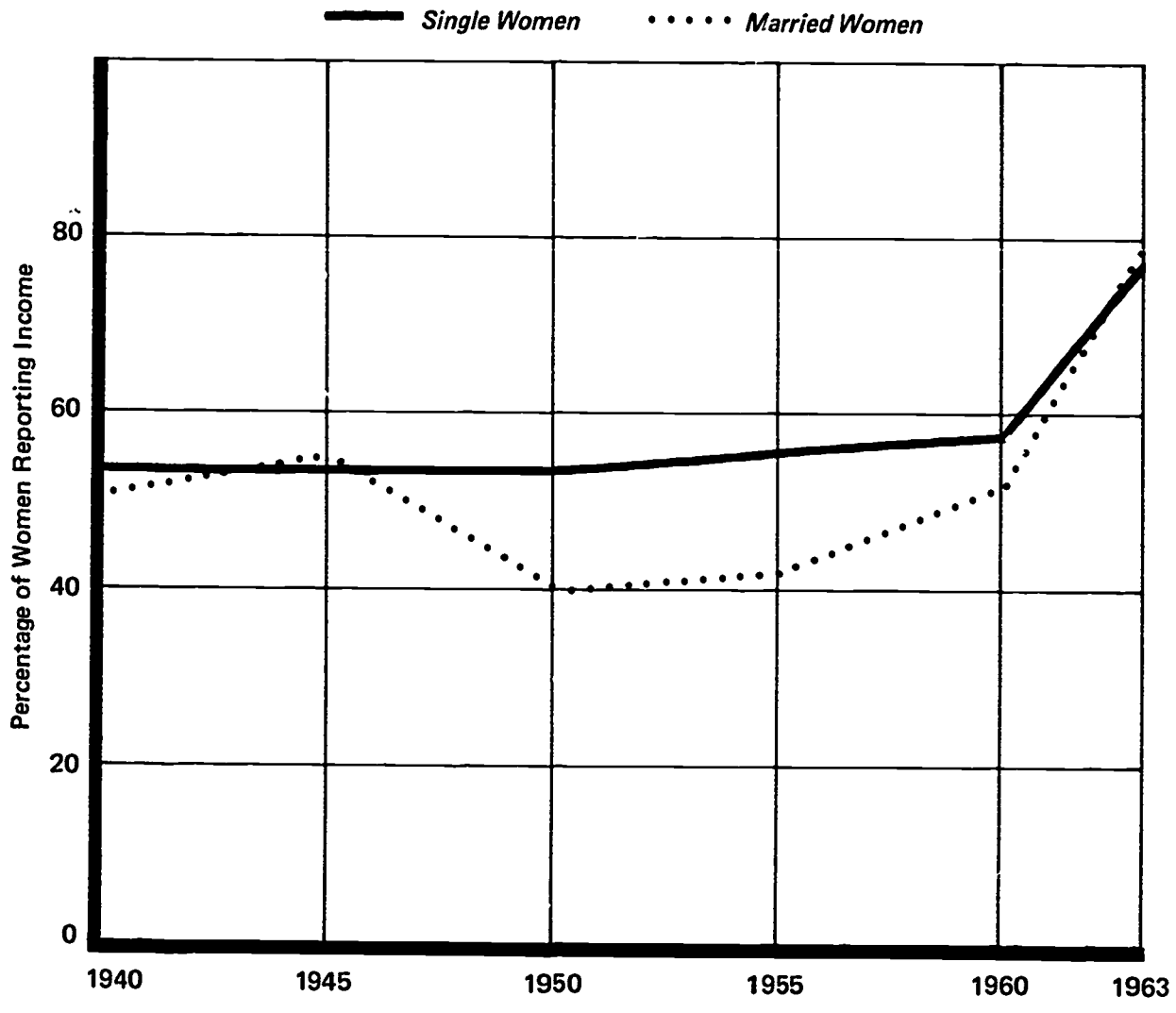
Families of Curves

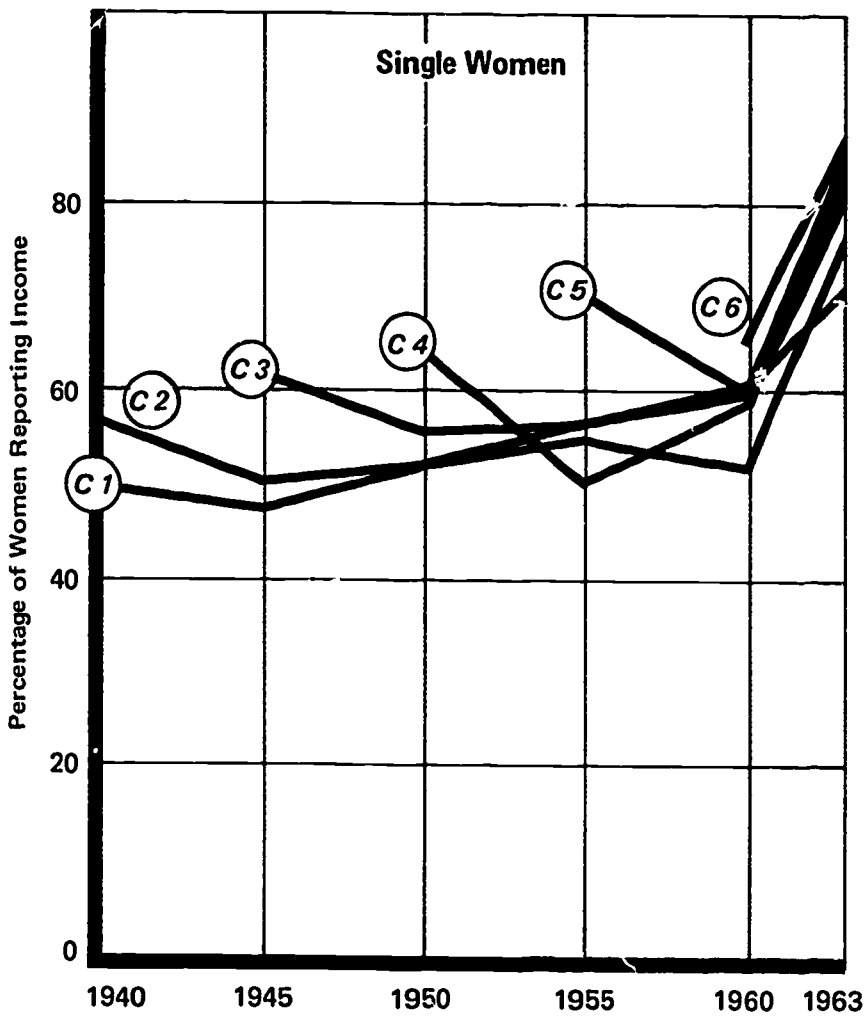
The simplified view obtained by combining cohorts conceals some very important data, as is shown by the other graphs in Figure 34. Each cohort for which a five-year or longer comparison is available shows a drop in the proportion reporting income five years after graduation. For the single women the drop is relatively small (around 10%); for married women it is large (around 20%). Both groups then show gradual increases up to 1960 and a further sharp rise in 1963. Although it is not shown on the chart, the latter rise is characteristic of the men also. The factor of memory no doubt enters the picture, as each of us is likely to remember his first salary and certain to know his present salary. In between, there is a gray area for most people, and apparently particularly for the women. For the married women, there are no doubt added complications associated with a period of increased family responsibilities, where outside earnings may be small or nonexistent. A further factor which probably complicates the present data is that of selective reporting.

Selective Reporting

The reasons for the low percentages of people reporting income between their first jobs and their present jobs are not available to us. The effect of such selective reporting was studied by calculating two sets of geometric mean salaries: one based on all available data and the other based on the salaries of those individuals who reported their salaries for every five-year interval requested (complete data cases). These data are reported in Table 26. Only experience groups AA and NN are reported, because in the "switch" groups there is the added complication of income variation associated with the change in employment. Data are given for each available time period, for all women, and separately for married and single women. At the bottom of the table, comparative data are given for the total sample, which is about 90% male. Data from Table 26 are portrayed graphically in Figure 35 (see page 94).

FIGURE 34
Percentage of Women Reporting Income, by Marital Status and Cohort





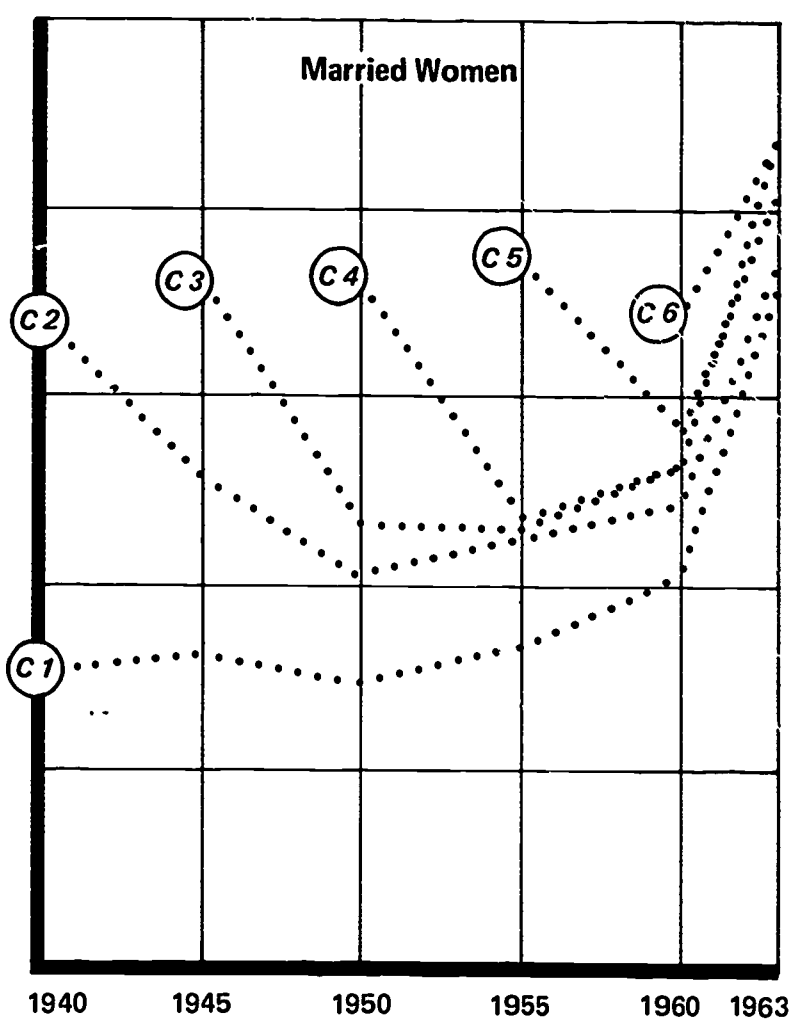
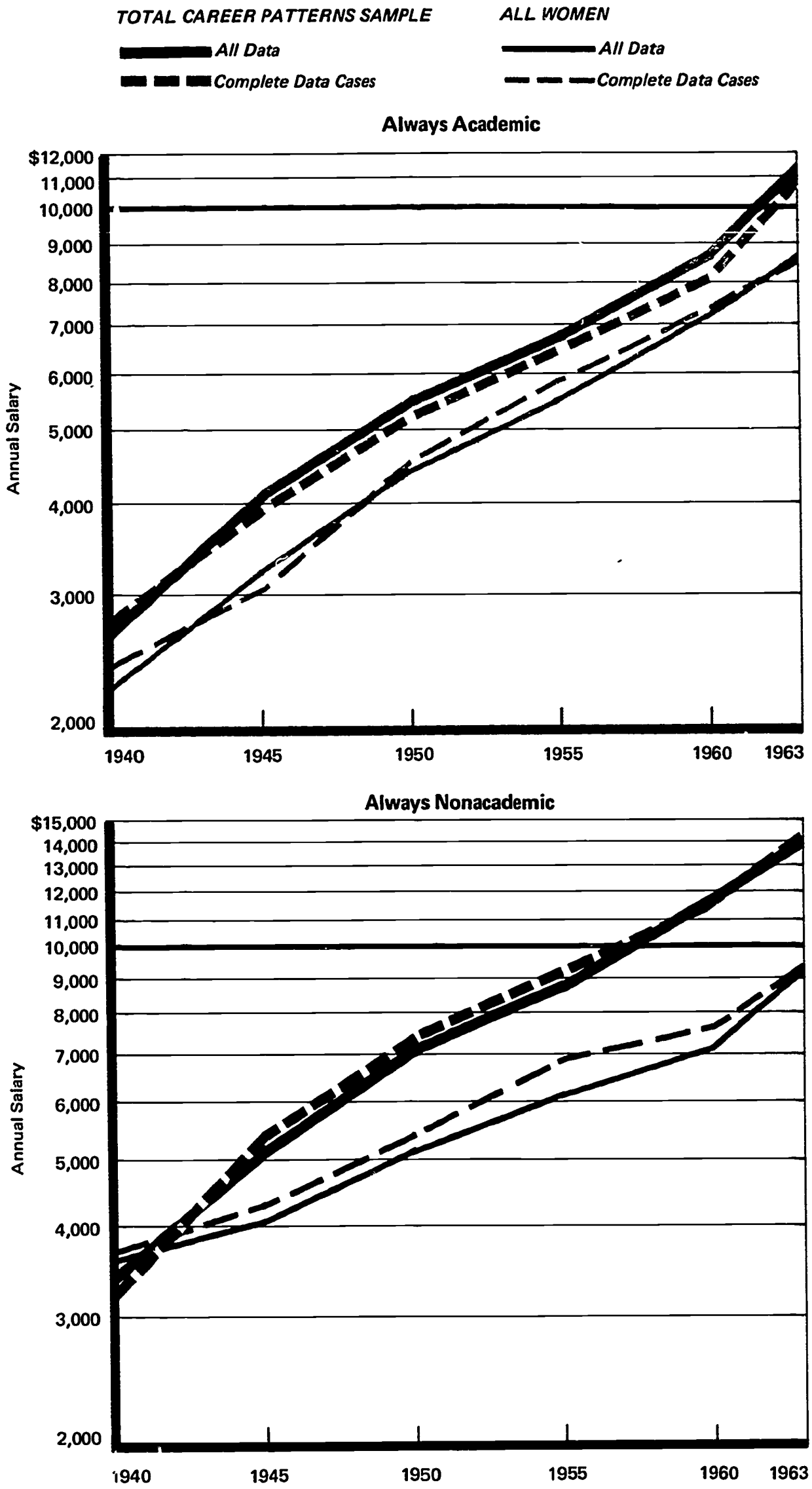


TABLE 26

Geometric Mean of Salaries and Number of Women Reporting Salary at Each Five-Year Interval (Complete Cases) Compared with Salaries Reported by All Women (All Available Cases), by Marital Status and Year

MARITAL STATUS OF WOMEN		SALARY AND NUMBER OF WOMEN REPORTING BY YEAR											
		1940		1945		1950		1955		1960		1963	
		COM-PLETE CASES	ALL AVAIL-ABLE	COM-PLETE CASES	ALL AVAIL-ABLE	COM-PLETE CASES	ALL AVAIL-ABLE	COM-PLETE CASES	ALL AVAIL-ABLE	COM-PLETE CASES	ALL AVAIL-ABLE	COM-PLETE CASES	ALL AVAIL-ABLE
ALWAYS ACADEMIC													
TOTAL WOMEN	Salary ($)	2,381	2,226	3,087	3,209	4,567	4,409	5,929	5,538	7,306	7,184	8,728	8,768
	Number	14	60	49	127	113	176	147	227	197	330	328	431
Married	Salary ($)	2,056	2,078	2,997	3,037	4,203	3,947	5,604	5,302	6,654	6,556	7,857	8,019
	Number	3	23	19	55	47	76	63	104	90	159	161	208
Single	Salary ($)	2,457	2,332	3,177	3,345	4,851	4,750	6,185	5,733	7,900	7,745	9,526	9,778
	Number	11	37	30	72	66	100	84	123	107	171	167	223
ALWAYS NONACADEMIC													
TOTAL WOMEN	Salary ($)	3,699	3,610	4,349	4,111	5,408	5,191	6,979	6,219	7,759	7,212	9,133	9,103
	Number	4	21	11	28	18	32	23	51	36	65	61	121
Married	Salary ($)	2,106	2,081	3,938	3,874	4,222	4,343	5,451	5,158	6,637	6,099	8,357	8,335
	Number	2	13	6	14	8	16	10	23	16	32	30	63
Single	Salary ($)	4,631	5,732	4,871	4,345	6,591	6,253	8,566	7,430	9,328	8,952	10,598	10,266
	Number	2	8	5	14	10	16	13	28	20	33	31	58
TOTAL CAREER PATTERNS SAMPLE													
Always Academic	Salary ($)	2,738	2,702	4,005	4,011	5,379	5,415	6,773	6,807	8,172	8,813	11,202	11,222
	Number	603	785	998	1,143	1,514	1,781	2,174	2,474	3,120	3,411	3,120	4,406
Always Nonacademic	Salary ($)	3,313	3,359	5,382	5,304	7,334	7,208	9,043	8,945	11,738	11,776	14,328	14,321
	Number	275	363	368	443	595	720	892	1,043	1,263	1,375	1,263	2,009

FIGURE 35
Geometric Mean of Annual Salaries of Women and Total Career Patterns Sample—All Available Data Compared with Complete Data Cases—All Fields and Cohorts



As can be seen in Figure 35, for the entire, predominantly male, sample, there are small differences between geometric-mean salaries based on complete data cases (broken line) and those based on all available data (solid line) for both the academic and nonacademic groups. For the women, differences between salaries based on complete data cases and those based on all available data are larger than for men. In the nonacademic group of women the salaries for complete data cases are always higher than those for all available data. Selective reporting apparently has little effect on the salaries of the entire, predominantly male, sample. However, for the women, the generally higher geometric-mean salaries for the group with complete salary data indicates that they are the more "successful" group, at least financially. The data in Table 26 for married and for single women indicate that in most instances the geometric-mean salary is higher for the complete data cases than it is for those with incomplete data.

Men Get $500 to $700 More

The general effect of such factors as differential reporting should be in the direction of an upward bias, if any, in the reported salaries of women, and particularly married women. This would then tend to diminish, rather than enhance, a sex differential; the sex differences reported are therefore on the conservative side. Of those always in academic employment, the comparison between the total (predominantly male) career patterns sample and the married and single women is shown graphically in Figure 36, for Cohorts 7 and 8 separately. The data for Cohort 7 for 1940–1950 are given in Table 26. For the period 1955–1963, Table 26 combines both cohorts. The data are tabulated

FIGURE 36
Geometric Mean of Annual Salaries of Always-Academic Group–Women by Marital Status and Total Career Patterns Sample–by Cohort, All Fields Combined

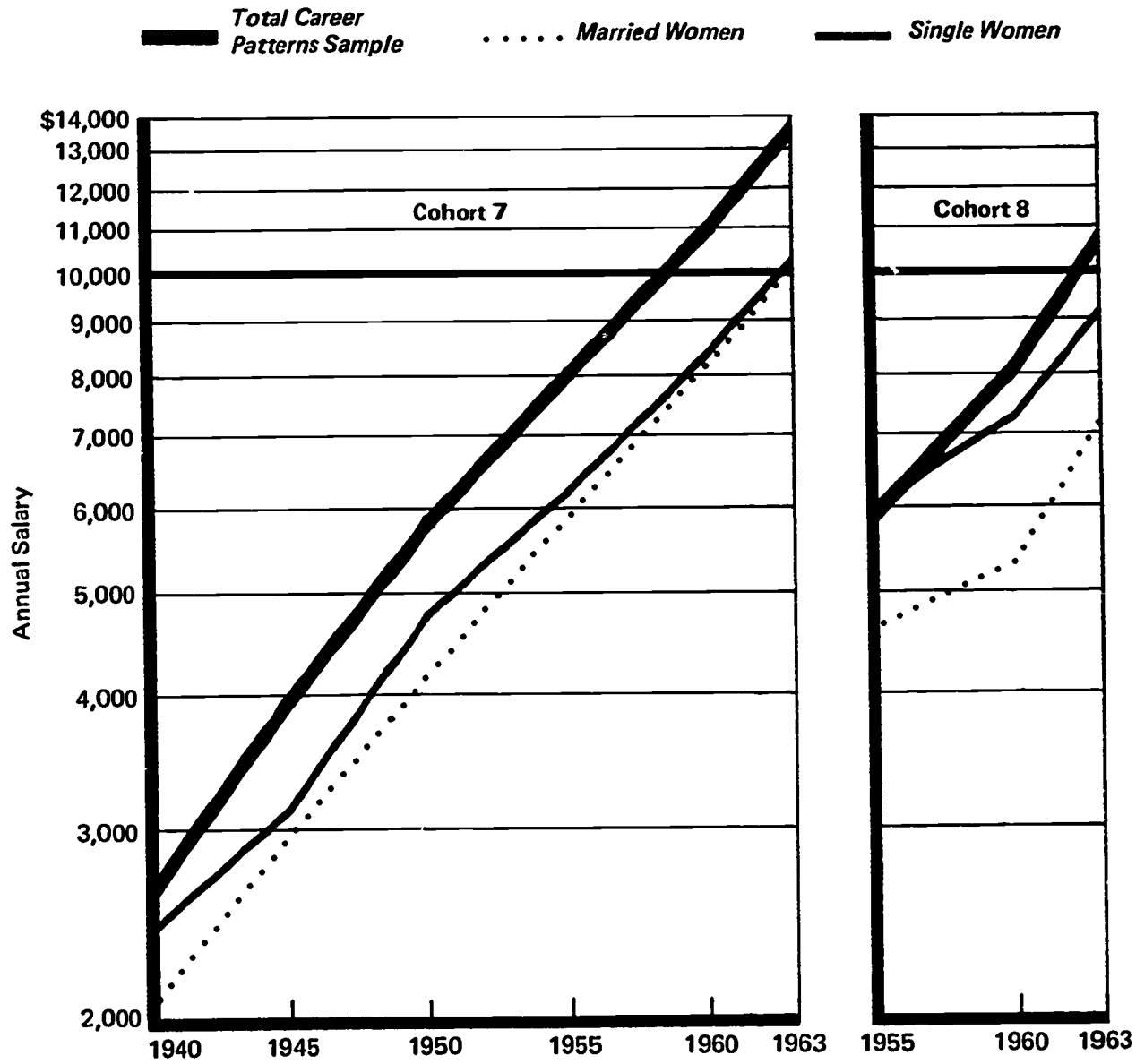


TABLE 27

Geometric Mean of Salaries of Always-Academic Women, Single and Married, and Total Career Patterns Sample, by Cohort and Year[a].

	GEOMETRIC MEAN OF SALARIES BY COHORT					
	COHORT 7			COHORT 8		
	WOMEN		TOTAL CAREER	WOMEN		TOTAL CAREER
YEAR	SINGLE	MARRIED	PATTERNS SAMPLE	SINGLE	MARRIED	PATTERNS SAMPLE
1940	$2,457	$2,058	$2,738			
1945	3,177	2,997	4,005			
1950	4,851	4,202	5,982			
1955	6,233	5,994	8,181	$6,054	$4,699	$6,042
1960	8,455	8,401	11,096	7,293	5,357	8,280
1963	10,275	10,051	13,840	9,198	7,127	10,803

[a]Data are included only for individuals who reported salary for every time interval after graduation.

in Table 27 for Cohorts 7 and 8 separately. For the entire career patterns sample, data comparable to Cohorts 7 and 8 were obtained by combining Cohorts 1, 2, and 3 and Cohorts 4, 5, and 6, respectively. Figure 36 is based on data from people who reported salary for every time period after graduation, thus controlling, to a degree, the selective effects of failure to report income. The geometric mean of the single women's salaries is about $500 per year less than that of the men, and for married women the differential is about $700 per year. In Cohort 7, the married–single differential gradually disappears, as the single women fall farther and farther behind the men in income level. For the shorter time period of Cohort 8, the trend is less clear; the three curves are roughly parallel, with the curve for single women between those of the married women and the total sample.

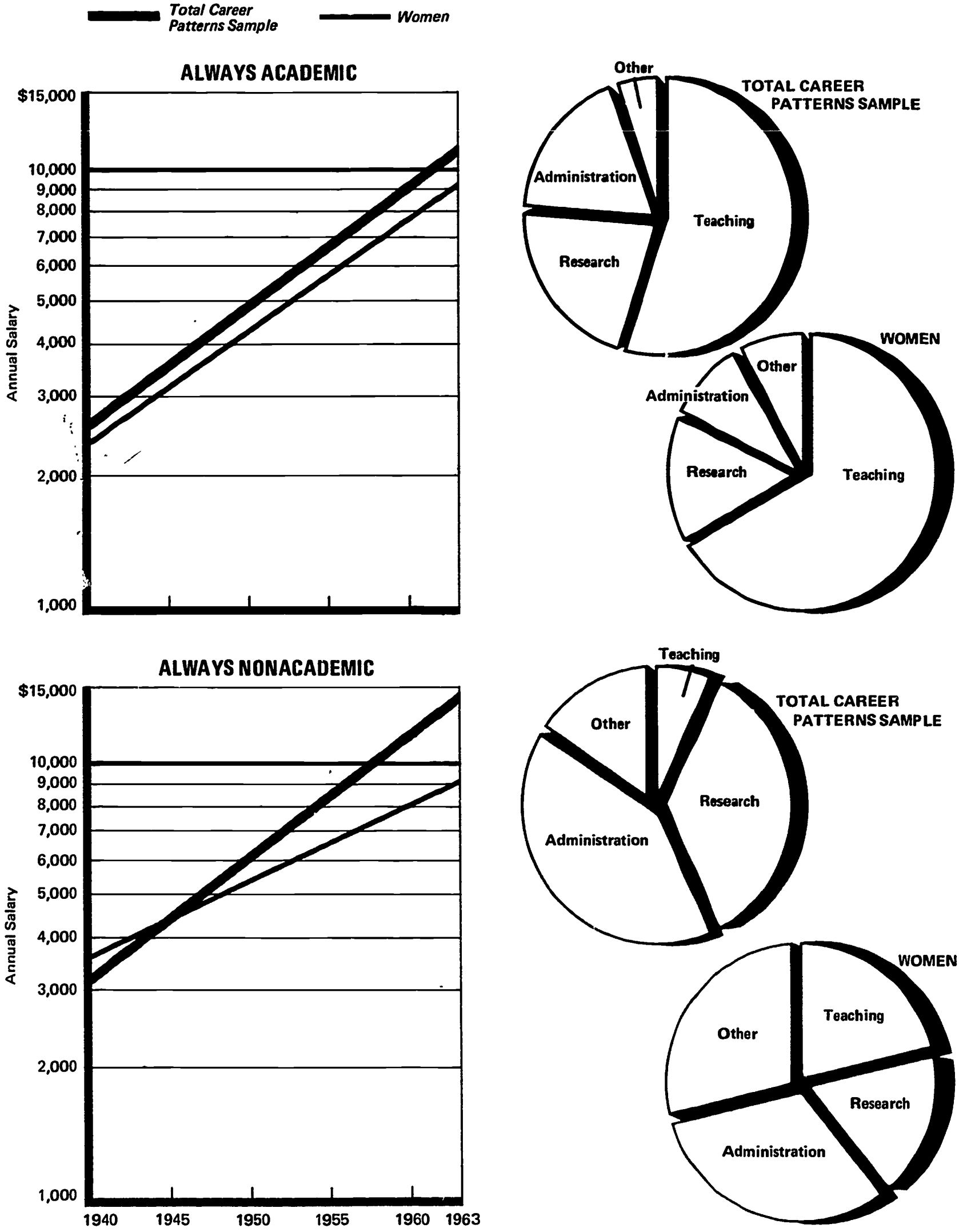
There are special effects on the salaries of women over and above those described in an earlier chapter on salaries of the entire (predominantly male) sample. Since some married women may be employed on a part-time basis, the salaries reported here may not give a measure of the full-time equivalent earnings of these women. In another study of over one thousand 1957–1958 women doctorate-holders,* 40% reported that they had experienced situations in which there were salary differentials favoring men. Married women might accept a salary lower than that offered men if the position could easily be accommodated to family responsibilities. As a second income, the actual amount might also be less critical—or even contribute to family harmony if it were not as large as the husband's income!

Salaries Vary by Function

Salaries are related to functions performed on the job. When women's salaries, within experience groups, are compared with those of men, the interaction of salary and function appears. Figure 37 shows this effect, with smoothed curves to simplify the diagram. For the always-academic group (all cohorts combined), women's salaries nearly parallel (at a lower level) the salaries of the entire sample. For the always-nonacademic group, salaries are much lower for women and diverge progressively. The percentage of time spent in different job functions is shown in circle graphs for the entire sample and for the women in the experience groups AA and NN. The far greater functional difference in the NN group

*Helen S. Astin, The Woman Doctorate in America: Family and Career Characteristics (unpublished manuscript).

FIGURE 37
Annual Salary and Employment Function of Women and Total Career Patterns Sample, All Fields and Cohorts Combined



is clearly apparent. In the AA group, women spend about half as much time in research as men. In the nonacademic group, the women spend about one third as much time in research as men. Since higher salaries are associated with research and lower salaries with teaching,* the relative amounts of time in teaching and research are reflected in the salaries of women in both the academic and nonacademic groups. The highest salaries, for men, are associated with a combination of administration and research (probably administration of research). In the case of women, it seems likely, even without explicit evidence, that the administrative functions indicated are qualitatively different from those of men in most instances. Information is limited concerning women who shift to and from academe, but the amount of discrepancy between women's salaries and those of the entire sample for the switch groups is intermediate between the AA and the NN groups.

SUMMARY OF CHAPTER IV

Slightly more than one in ten of the PhD's in this sample are women, the same proportion as in the current total doctorate output. In the social sciences and humanities, arts, professions, there is a relatively large proportion of women, while in the physical sciences a very small proportion are women.

The proportion of women in always-academic positions is comparable with that of men, but there is a small proportion of women in always-nonacademic positions and a larger proportion of women who shift to and from academe.

Women receive less support for graduate education than do men, particularly from governmental sources. Single women provide more of their own support than do married women, even when husband's income is counted as "own." Surprisingly, a larger proportion of women than men receive postdoctoral fellowships, particularly among bioscientists who later go into academic careers.

Women progress less rapidly up the academic ladder than do men and receive less support for research than do men. Many more of them depend on a single source of support. They do correspondingly less research and much more teaching than do men, even in nonacademic positions. Young bioscientists spend more time in research than do the older bioscientists.

Salaries received by married women are in general about 70% to 75% of those received by men at the same time interval after receipt of the doctorate. Salaries of single women are more variable, but on the average they are somewhat higher than those of the married women though still markedly lower than men's salaries.

*See Lindsey R. Harmon, Profiles of Ph.D's in the Sciences, Chap. 7, NAS-NRC Publ. 1293, Nat. Acad. Sci.–Nat. Res. Council, Washington, D.C., 1965.

APPENDIX A CALCULATION OF SAMPLE WEIGHTS

Weighting factors were used to obtain a proper balance of the various groups in the statistical data of this report. These weights were computed by assigning to each individual a multiplier that expresses that individual's representativeness within his graduation cohort, sex, and field. For this purpose, the 24 fields defined in Profiles of Ph.D's in the Sciences were used, as were males and females of the individual cohorts. For example, if there were 215 PhD's in a particular field in a particular year, and there were only 98 usable replies received, each individual in that group would receive a weight of 215/98, or 2.19. If the total

TABLE A-1
Sample Weights

FIELD OF DOCTORATE	COHORT 1		COHORT 2		COHORT 3		COHORT 4		COHORT 5		COHORT 6	
	MALE	FEM	MALE	FEM	MALE	FEM	MALE	FEM	MALE	FEM	MALE	FEM
Phys .ogy	1.9	1.7	1.6	1.6	1.5	2.0	1.6	2.6	1.3	5.0	1.3	1.5
Pharmacology	1.6	2.0	1.9	[a]	1.3	1.0	1.4	1.5	1 4	1.6	1.5	1.0
Biochemistry	2.1	1.6	1.5	1.5	1.6	1.5	1.4	1.3	1.5	1.4	1.3	1.5
Microbiology	1.5	2.3	1.5	1.5	1.6	1.3	1.4	1.7	1.4	1.9	1.4	1.4
Botany	2.9	4.0	4.3	2.2	1.4	1.8	2.4	7.0	1.8	2.6	2.3	2.2
Genetics	1.4	2.0	1.6	[a]	1.2	1.0	1.4	[a]	1.4	1.5	1.3	2.0
Zoology	4.8	4.1	3.7	4.1	1.5	1.3	2.6	2.8	3.3	5.2	2.6	3.9
Misc. Biology	1.6	1.5	1.0	[a]	1.5	[a]	[a]	[a]	1.4	1.0	1.2	1.8
Agriculture	1.6	1.0	2.3	[a]	1.4	1.0	2.5	1.0	2.7	1.0	3.6	[a]
Medical Sciences	1.6	2.5	2.0	1.5	1.4	1.4	1.4	2.0	3.0	1.8	1.5	1.7
Psychology	3.7	4.2	3.0	2.9	1.9	1.9	3.7	4.5	10.1	9.9	8.6	16.6
Sociology	1.6	1.5	2.9	2.9	1.8	1.9	2.8	3.0	2.9	3.0	2.5	2.0
Economics	3.3	3.2	3.5	3.0	1.8	1.4	4.8	3.5	4.3	9.5	4.6	4.5
Political Science	1.9	1.6	3.1	3.2	2.2	1.2	2.1	2.0	2.8	2.4	2.9	3.6
History–Geography	5.4	5.6	6.4	8.7	2.2	4.0	3.8	8.7	5.1	5.8	4.4	3.4
Mathematics	2.3	2.0	3.2	3.4	1.4	1.5	2.5	5.5	2.5	3.7	2.9	2.7
Physics	3.9	6.0	4.6	[a]	1.6	3.0	4.7	3.0	7.3	6.0	8.4	6.0
Chemistry	10.9	13.3	12.5	22.5	7.8	8.4	13.7	12.3	13.4	5.3	12.0	22.5
Geology	2.4	[a]	1.6	3.0	1.6	1.2	1.2	1.5	2.5	1.0	3.1	1.5
Engineering	2.5	[a]	3.3	[a]	3.4	[a]	4.8	[a]	7.4	[a]	8.6	[a]
Languages and Literature	7.9	11.3	9.8	12.4	5.3	5.9	6.7	8.4	10.4	8.7	7.5	7.9
Arts and Humanities	2.2	3.7	2.3	3.5	1.9	1.5	2.2	1.8	3.0	7.7	4.5	6.2
Professions	4.8	6.0	4.6	2.5	3.2	4.3	3.5	3.6	4.9	3.6	3.8	4.3
Education	13.6	17.1	18.2	17.5	8.3	10.7	15.3	14.5	19.8	28.1	19.1	16.4

[a]No cases in sample and 10 or less in population.

number of graduates in another field in a particular year was 87, and 63 usable replies were received, the individuals in this group would receive a weight of 87/63, or 1.38. When fields or cohorts were combined, these weights would be carried along with individuals, so that the combination would retain its proper proportionality. The weighting then compensated for the fact that in some fields and cohorts the response rates were higher than in others, as in the two examples given above. The final results, then, would not be biased because of the higher response rates of a particular group but would approximate what would have been found if there had been a 100% response in all fields and cohorts. The weights which were actually used are given in Table A-1. The use of these weights does not, of course, compensate for small numbers of cases in any particular instance, as random fluctuations are multiplied by the same coefficients. The original numbers were used in any calculations of standard errors.

APPENDIX B VARIATION AMONG EXPERIENCE GROUPS ON PREDOCTORAL VARIABLES

One of the basic questions that had to be resolved in analyzing data on the various experience groups was whether the differences that are found were due to characteristics antedating receipt of the doctorate or were due only to influences felt in professional careers following receipt of the doctorate. It would be important to know, for example, whether such things as size and type of high school were related to later career pattern. It would be even more important to know whether the support received in pursuit of graduate education was related to later career pattern. This is particularly important from the standpoint of support agencies, because if it were found that a particular pattern of support during graduate education could be causally related to later careers, it would furnish a basis for policy decision by fund-granting agency. For these reasons, an examination was made of all variables available in the record, for periods antedating receipt of the doctoral degree, to determine whether any of them were associated to a statistically significant degree with later experience patterns, as shown by the various experience groups—those remaining in academic work, those remaining in nonacademic work, and those who switched back and forth. This study was done early in the analysis because of its fundamental relationship to any later studies and involved six experience groups, rather than four: those who switched back and forth between academic and other employment more than once were treated separately, according to whether their 1963 employment was academic or other.

A standard technique for determining whether significant differences exist among various groups on a particular variable is that of analysis of variance. In the present instance, however, some of the assumptions usually required for analysis of variance were not met, and corrections for variations from these assumptions would be elaborate and difficult to make and to explain. The various groups were not equal in size, and furthermore the sets of means to be compared were computed on the "blown-up" figures, rather than the original numbers of cases. These "blown-up" numbers are, of course, unsuitable for computation of standard errors; the size of the error is a function of the actual number of cases, regardless of the base population from which the sample is drawn. So the original N's would be needed in the analysis of variance. None of these difficulties was unsurmountable, but in combination they are formidable, and each would require extensive modification of the standard computer programs. Computation by hand calculator was out of the question because of the very large number of tests that would be required.

A Graphic Substitute

Rather than use the analysis of variance technique, a relatively crude but adequate graphic method was used to compare the actual distribution of means of the six experience groups with what would be expected from a random sample of means drawn from a single population, with sample sizes equal to those actually found in the various experience groups for each of the predoctoral variables. The spread of mean values to be expected statistically was com-

puted, and the range of this expectation marked out on a tabulation sheet which also had the actual variations in means as found in the empirical data. If the empirical data were distributed differently from what would be expected on a purely chance basis, it would suggest that the particular variable ought to be examined more closely for a significant relationship to career pattern. If, on the other hand, the empirical distributions of means fell within chance expectations, one would not be justified in imputing any significant relationship to the variations found.

1.5 σ = Interquartile Range

The first step was to compute the expected chance variations. The formula for the standard error of a mean value is:

$$\text{standard error} = \sigma/(\underline{N} - 1)^{1/2},$$

where σ is the standard deviation of the total group, and N is the number of cases in a particular subgroup. For convenience in dealing with all these variables on a common basis, all the actual group data were converted from the original scales to a standard score scale, in which the mean of the over-all group is set at 50 and the standard deviation at 10. We are thus provided a common metric for all the variables involved. For simplicity in comparing the expected with the empirical distribution of means, it was noted that 1.5 times the standard error is a value approximately equal to the interquartile range in an empirical distribution. The interquartile range of the empirical distribution can be determined by inspection for a distribution of six means, as it is the difference between the next-to-highest mean and the next-to-lowest mean. This follows from the fact that each of the six means is taken to represent one sixth of the whole distribution, or a 16.67 percentile range, and is assumed to fall in the middle of this range. The position of each of the six means is then as follows, in percentile terms:

	Percentile
lowest =	8.33
second =	25.00
third =	41.67
fourth =	58.33
fifth =	75.00
sixth =	91.67

The difference between the second and fifth is obviously the interquartile range.

Standard Errors for Varying N's

For any given variable, there were four fields, six cohorts, and six experience groups, or a total of 144 means to be compared in groups of six, or 24 interquartile ranges to be computed. Because of missing data, the numbers of cases in these 144 groups were not constant for the several variables but ranged from 3 to close to 1,000 cases. The size of the standard errors with which the interquartile ranges are to be compared is, of course, a function of the number of cases, so that a distribution of these numbers, with associated standard error terms, is essential to compare with the distribution of empirical interquartile ranges. Tabled below are the values of standard error x 1.5, for varying values of N. Values for numbers of cases over 1,000 are given for reference purposes, in considering the accumulations across fields and cohorts, even though there might be no practical value to differences which require such large N's in order to achieve statistical significance.

N	S.E. × 1.5	N	S.E. × 1.5	N	S.E. × 1.5	N	S.E. × 1.5
3	1.061	22	0.327	65	0.188	300	0.087
4	0.866	23	0.320	70	0.180	350	0.080
5	0.750	24	0.313	75	0.174	400	0.075
6	0.671	25	0.306	80	0.169	450	0.071
7	0.612	26	0.300	85	0.164	500	0.067
8	0.567	28	0.289	90	0.159	550	0.064
9	0.530	30	0.279	95	0.155	600	0.061
10	0.500	32	0.269	100	0.151	650	0.059
11	0.474	34	0.261	110	0.144	700	0.057
12	0.452	36	0.254	120	0.138	750	0.055
13	0.433	38	0.247	130	0.132	800	0.053
14	0.416	40	0.240	140	0.127	850	0.051
15	0.401	42	0.234	150	0.123	900	0.050
16	0.387	44	0.229	160	0.119	950	0.049
17	0.375	46	0.224	170	0.115	1,000	0.047
18	0.364	48	0.219	180	0.112	2,000	0.034
19	0.354	50	0.214	190	0.109	3,000	0.028
20	0.344	55	0.204	200	0.106	4,000	0.024
21	0.335	60	0.195	250	0.095	5,000	0.021

The values of S.E. × 1.5, from the preceding table, together with the empirical distribution of N's for eight of the predoctoral variables, are shown graphically at the top of Figure B-1 (see following page). Ranged below are the empirical distributions of interquartile ranges for each of the eight predoctoral variables other than support of graduate education.

The Distributions Match

The two sets of distributions illustrate the high degree of correspondence between theoretical and empirical values, for these eight predoctoral variables. Visual inspection suffices to show that there is a good fit; in order for the empirical values to be of any practical significance, they would have to be much greater than they are. If any particular variable repeatedly showed up with a distribution of values equal to the high end of the theoretical value distribution, it would be worthy of further examination. The only predoctoral variables that did show significant differences were those concerned with support for graduate education. Some minor but rather consistent relationships were found between graduate school support and later careers. These relationships were described in detail in Chapter III and are not described further here.

Fields Do Vary

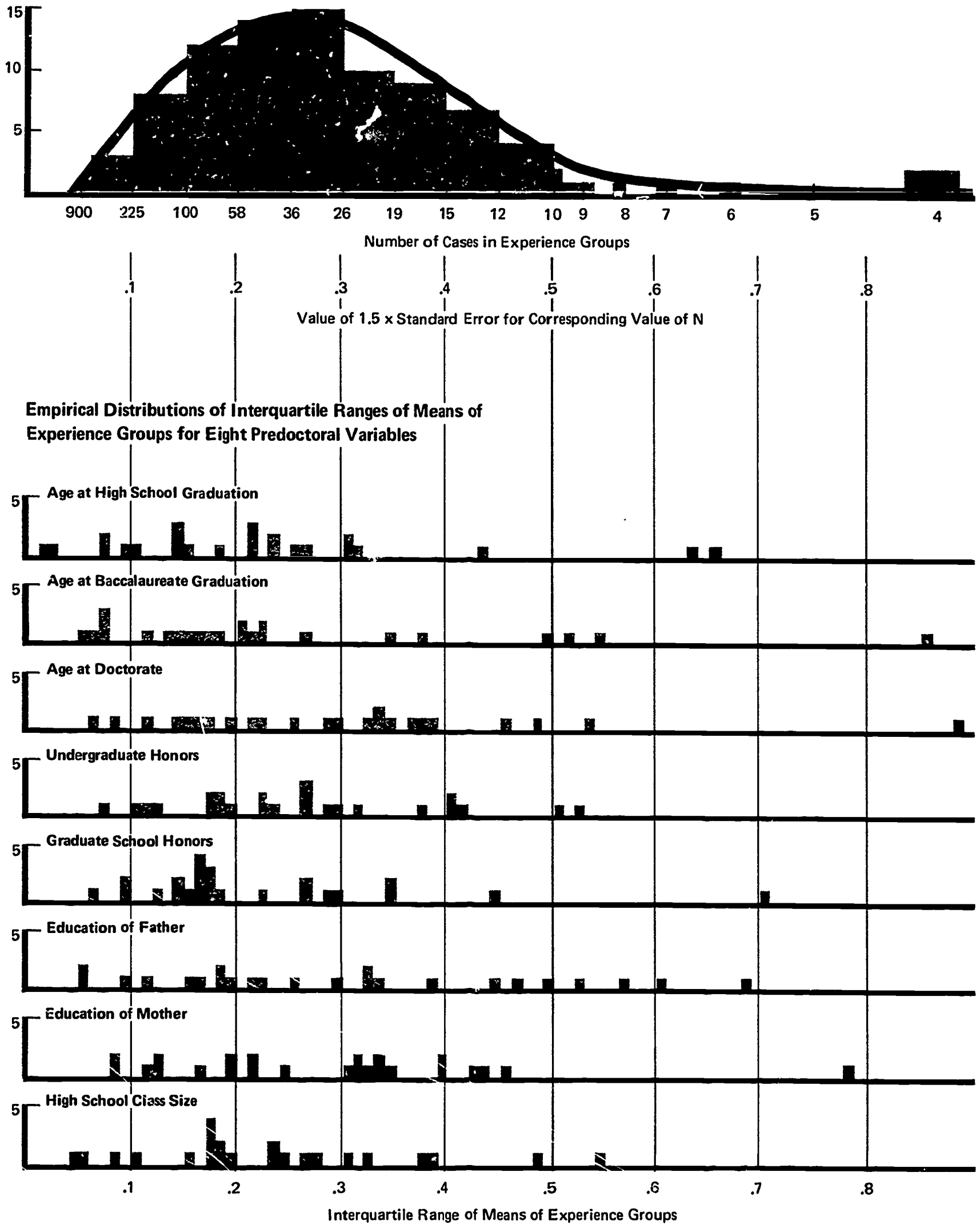
It should be noted here that field variations do not show up in Figure B-1. The interquartile ranges from the several fields are combined in order to control field differences and focus attention upon the variations among the experience groups. By separating the fields and combining experience groups, the field differences can be displayed in a similar fashion. When this was done, it was found that there were significant field differences, but these plots were omitted as irrelevant to the present report.

In Conclusion

In summary, the examination of predoctoral variables showed that none except support for graduate education showed other than random-sampling variations among the experience groups. The analyses of variables related to the present job situation, and its relation to employer-category shifts, could proceed without danger that the variations found were related to factors inherent in the individuals rather than in the situations themselves.

FIGURE B-1

Graphic Comparison of Theoretical and Empirical Values of Standard Errors of Means on Eight Variables



APPENDIX C FURTHER INFORMATION ON CAREER PATTERNS

Tables C-1 and C-2 are both related to career patterns following graduation. This detailed information is provided here for those readers who may wish to study [illegible] individual subgroups not included in the text.

Table C-1 is a companion to Table 14, page 53. Table C-2, which shows the [illegible]s of the shift groups (NA and AN), is an expansion of Table 9 on page 34 [illegible]pter II.

TABLE C-1

Percentage Time Distribution among Research, Administration, Teaching, and Other Functions, by Experience Group and Year, Cohort 1 (PhD's of 1935)

			PERCENTAGE OF PHD'S BY EXPERIENCE GROUP					
			NONACADEMIC TO ACADEMIC			ACADEMIC TO NONACADEMIC		
YEAR	FUNCTION	ALL EXPERIENCE GROUPS COMBINED	ABOUT TO SHIFT	JUST SHIFTED	ALWAYS ACADEMIC	ABOUT TO SHIFT	JUST SHIFTED	ALWAYS NON-ACADEMIC
1940	Teaching	45.3	7.5	53.1	64.8	50.7	3.2	7.4
	Research	30.9	17.0	30.0	21.5	36.3	50.4	51.6
	Administration	15.8	49.8	9.5	10.0	10.2	24.1	25.0
	Other	8.1	25.7	7.3	3.7	2.8	22.2	16.0
1945	Teaching	37.1	3.1	56.6	58.5	50.7	8.2	6.5
	Research	28.5	35.4	13.5	20.7	30.7	47.9	39.2
	Administration	24.9	48.3	20.6	15.6	11.6	33.5	40.1
	Other	9.6	13.2	9.4	5.2	7.0	10.4	14.3
1950	Teaching	37.8	22.7	58.9	55.4	53.3	3.9	6.7
	Research	25.3	27.7	17.2	20.7	15.9	38.1	33.3
	Administration	28.8	39.7	19.6	19.3	12.9	40.1	45.8
	Other	8.1	9.9	4.3	4.7	17.9	18.0	14.2
1955	Teaching	35.6	5.4	48.8	52.8	27.3	4.4	7.0
	Research	25.0	29.9	28.5	20.6	27.8	31.8	29.4
	Administration	30.9	53.2	18.8	21.8	35.7	30.9	48.7
	Other	8.5	11.6	3.9	4.9	9.2	33.0	14.9
1960	Teaching	33.6	26.1	53.7	49.8	36.2	4.0	7.2
	Research	24.0	22.9	16.9	20.6	13.1	29.5	26.9
	Administration	33.1	38.9	20.6	24.7	48.2	30.8	51.8
	Other	9.3	12.1	8.9	4.9	2.4	35.7	14.1
1963	Teaching	33.8	—	56.5	48.8	—	1.0	7.0
	Research	24.2	—	17.9	20.4	—	39.9	27.9
	Administration	32.1	—	24.2	25.7	—	42.0	50.0
	Other	9.9	—	1.4	5.1	—	17.1	15.1

TABLE C-2

Geometric Mean of Salaries for Academic-to-Nonacademic and Nonacademic-to-Academic Groups by Time Periods of Shift, by Cohort

COHORT	EXPERIENCE GROUP	TIME PERIOD OF SHIFT	NUMBER OF CASES[a]	GEOMETRIC MEAN OF SALARIES BY YEAR					
				1940	1945	1950	1955	1960	1963
1	Nonacademic to Academic	1935 to 1940	26	$4,265	$6,013	$9,203	$11,698	$14,809	$18,231
		1940 to 1945	17	3,564	4,728	6,324	8,124	11,010	9,895
		1945 to 1950	44	2,869	5,088	6,762	9,207	12,563	15,202
		1950 to 1955	15	3,374	4,914	8,705	10,259	13,781	15,098
		1955 to 1960	11	3,618	4,668	8,011	10,812	5,672	6,202
		1960 to 1963	12	3,943	6,045	9,078	12,595	14,942	13,280
	Academic to Nonacademic	**1935 to 1940**	**30**	3,721	5,722	8,329	11,025	14,080	13,513
		1940 to 1945	**39**	2,813	5,325	7,900	10,165	13,240	15,474
		1945 to 1950	**25**	3,078	4,593	8,128	10,725	13,981	15,962
		1950 to 1955	**20**	2,967	4,478	5,637	10,179	13,189	13,409
		1955 to 1960	**9**	4,285	5,872	11,021	11,056	18,664	22,198
		1960 to 1963	**14**	3,261	5,066	8,487	10,649	12,543	15,452
2	Nonacademic to Academic	1940 to 1945	28	2,592	3,606	5,924	8,298	11,801	14,849
		1945 to 1950	58	2,922	5,029	6,678	9,831	12,169	14,663
		1950 to 1955	16	2,871	5,204	7,748	10,320	13,143	16,455
		1955 to 1960	20	3,079	5,571	5,204	7,748	10,320	13,143
		1960 to 1963	15	2,700	4,360	7,058	9,515	11,556	12,609
	Academic to Nonacademic	**1940 to 1945**	**78**	2,375	4,909	8,880	12,247	15,889	19,090
		1945 to 1950	**35**	2,442	4,421	8,224	11,021	14,501	17,361
		1950 to 1955	**34**	2,502	4,242	5,522	10,188	11,159	13,957
		1955 to 1960	**16**	3,258	4,920	7,454	8,499	13,034	17,188
		1960 to 1963	**6**	3,452	5,682	7,945	11,352	13,005	15,978
3	Nonacademic to Academic	1945 to 1950	38	–	4,482	5,569	7,681	10,060	13,430
		1950 to 1955	13	–	3,655	5,411	5,789	8,738	11,094
		1955 to 1960	21	–	4,223	6,029	9,518	11,421	13,421
		1960 to 1963	18	–	4,119	7,178	10,447	14,242	17,683
	Academic to Nonacademic	**1945 to 1950**	**43**	–	3,584	6,772	10,459	14,630	16,896
		1950 to 1955	**38**	–	3,764	5,654	9,953	13,231	15,987
		1955 to 1960	**21**	–	3,803	3,604	7,632	12,371	13,573
		1960 to 1963	**16**	–	4,466	6,729	9,395	12,746	18,183
4	Nonacademic to Academic	1950 to 1955	35	–	–	4,659	7,797	11,496	14,433
		1955 to 1960	46	–	–	4,924	8,143	10,114	12,532
		1960 to 1963	34	–	–	4,872	7,607	11,634	12,123
	Academic to Nonacademic	**1950 to 1955**	**76**	–	–	4,926	9,110	13,018	16,238
		1955 to 1960	**60**	–	–	5,135	7,132	13,935	16,919
		1960 to 1963	**38**	–	–	5,068	7,079	10,996	15,168
5	Nonacademic to Academic	1955 to 1960	77	–	–	–	6,437	9,207	11,714
		1960 to 1963	48	–	–	–	6,311	9,212	10,534
	Academic to Nonacademic	**1955 to 1960**	**74**	–	–	–	5,419	9,661	12,386
		1960 to 1963	**53**	–	–	–	6,227	8,923	13,536
6	Nonacademic to Academic	1960 to 1963	102	–	–	–	–	7,913	9,256
	Academic to Nonacademic	**1960 to 1963**	**112**	–	–	–	–	6,633	10,397

[a]Number of cases based on individuals who reported income for all time intervals.